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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILDLIFE THROUGH EDUCATION"

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ERRATUM

Fourth Progress Report on the Cooperative Study of The Interstate Deer Herd and Its Range. Vol. 36, No. 1, pp. 27-52, January 1950.

All material on page 40 and the first paragraph on page 41 should be inserted ahead of the second paragraph on page 35 just under Figure 8. When this correction is made, the section "Forage Studies" starting on page 36 will read in logical sequence.

NOTES ON SOME PACIFIC FISHES [1]

By JOHN E. FITCH
Bureau of Marine Fisheries
Division of Fish and Game

HAWAIIAN WATERS

Pegasus sp., Seamoth

During August and September, 1948, the crew of the Bureau of Marine Fisheries research vessel *N. B. Scofield* caught a number of yellowfin tuna *(Neothunnus macropterus)* while in Hawaiian waters. These were collected for use in population studies and were kept frozen until the vessel returned to California. The author checked the stomach contents of each specimen and found that most of them had fed upon an assortment of small fish and crustaceans and were fairly well gorged. A partially digested seamoth (*Pegasus* sp.) and the seahorse reported by Herald (1949) were both found in the same tuna, and were the only fish forms in that particular stomach. A few species of seamoths have been reported from tropical waters throughout the world, but they are nowhere common.

Masturus lanceolatus (Lienard), Pointed-tailed ocean sunfish.

Gudger (1936a and b, 1937 and 1939) gives some extensive reports on the post-larvae of the pointed-tailed ocean sunfish. He states that there were only 59 authenticated records of *Masturus lanceolatus* in the 100 years after its discovery in 1836. It has been recorded from nearly every tropical and sub-tropical sea in the world. One of the most common species found in the stomachs of the yellowfin tuna taken by the *N. B. Scofield* in Hawaiian waters was *Masturus lanceolatus*. Nearly a hundred post-larvae ranging in size from one-fourth inch to nearly two inches in diameter were taken from the stomachs of most of the 55 tuna examined. A quarter-inch specimen has a pea-shaped, apparently finless body covered with short, heavy spines and in no way resembles the huge adult. According to Gudger (1936a) the smallest individual on record was one-tenth inch long while the largest was over 10 feet long and weighed about 1,700 pounds.

MEXICAN WATERS

Platyrhinoidis triseriata (Jordan and Gilbert), Thornback.

Two specimens of *Platyrhinoidis triseriata* were taken in set gill nets by the *N. B. Scofield* on the night of November 19, 1948. The nets were anchored on the Pacific shore of Lower California in 12 fathoms of water directly opposite San Martin Island. (Latitute 30° 27.7′ N., longitude 116° 04.8′ W.) Walford (1935) gives the range for this species as the coast of California from Pt. Conception southward. Hubbs (1916b) found a thornback on the beach just north of Pt. Conception and offered this as the northernmost record for the species. The present specimens extend the known range of the thornback southward some 130 miles.

[1] Submitted for publication December, 1949.

Prionotus stephanophrys Lockington, Searobin (Figures 12 and 13)

Two searobins were taken by the *N. B. Scofield* in November 1948. One was caught in drift gill nets during the night of November 13, 1948, on the south shore of Sebastian Viscaino Bay, Lower California. (Latitude 27° 53′ N., longitude 114° 50′ W.) These nets were fished from 8 to 16 fathoms beneath the surface in 27 fathoms of water. The second was hooked by one of the crew members fishing with a hand line at the same locality on the morning of November 14, 1948.

The following color notes were made by Mr. Phil M. Roedel of California Bureau of Marine Fisheries on the two Lower California specimens some eight hours after their capture: "Upper part of the head olive, flushed with reddish; a few small red brown spots on top of the head. Pinkish orange spot behind jaw. Lower jaw white; upper branchiostegals yellowish. Back (above a line from upper edge of pectoral to caudal) olive with silvery reflections and spotted with dark brown and brownish orange. A broad streak of salmon along lower side extending to anal. Belly in front of anal white. First dorsal orange brown becoming dark at edge; approximately eight dark spots on membrane. Second dorsal paler, flushed with salmon and with many dark brown spots. Caudal brownish, flushed with salmon and with several dark brown spots. Anal pale flushed with salmon, brownish shades in membrane near edge. Pectorals grayish brown spotted with deep brown, tending to black. Pelvics white flushed with salmon. Inside of cheeks deep purplish red."

In January, 1949, Mr. Robert Wedgewood of the Bureau of Marine Fisheries picked up a third *Prionotus stephanophrys* about a mile off the Malibu Pier at the north end of Santa Monica Bay while making a routine check of fish killed by detonation of explosives during oil exploratory work. It had essentially the same color pattern. Santa Monica Bay is the only locality in Southern California from which this species is known. It has been recorded there twice before (Hubbs, 1945, Daugherty, 1946).

The dorsal, anal, pectoral, pelvics and caudal ray counts of all three specimens agree with those given by Hubbs (1945). The gill raker counts on the upper and lower limbs of the outer arch for the three specimens recorded in this paper are: Santa Monica Bay, 5, 16; Lower California hook and line, 4, 15; Lower California net, 4, 18. The following measurements all in millimeters are presented in order to supplement available data on *P. stephanophrys*.

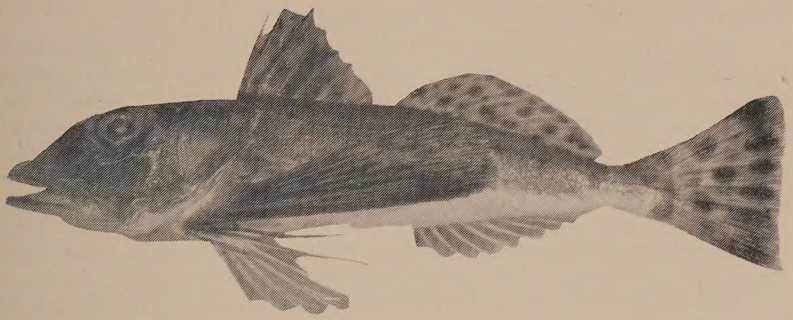

FIGURE 12. Searobin. *Prionotus stephanophrys. Photograph by Al Johns for Vernon M. Haden, San Pedro*

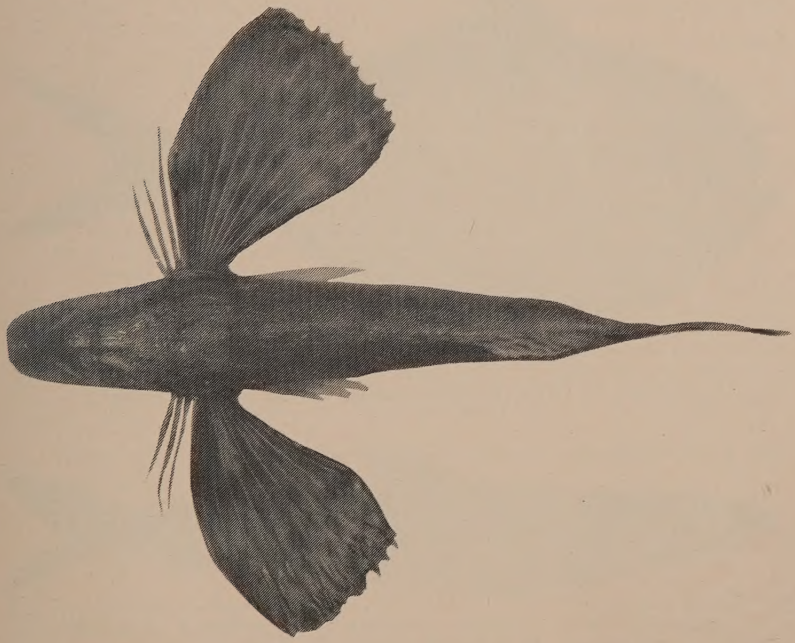

FIGURE 13. Dorsal view of searobin showing pectoral fins extended. *Photograph by Al Johns for Vernon M. Haden, San Pedro*

	Santa Monica Bay	*"N. B. Scofield" hook and line*	*"N. B. Scofield" net*
Standard length	270	193	191
Total length	331	240	237
Head	93	73	72
Depth	62	38	42
Snout	38	28	27
Eye	18	15	14
Maxillary	38	28	27

Brama brama (Bonaterre), Pomfret (Figure 14)

About August 15, 1949, the crew of the seiner *Nancy Rose* took a 15-inch pomfret in their seine while fishing for tuna off Guadalupe Island, Lower California. The skipper, Mr. Ben Fukuzaki, brought the specimen to the laboratory for identification. Jordan (1924) reported one specimen from San Diego, one from Santa Catalina Island and one from Queen Charlotte Island, British Columbia. Snyder (1920) reported two taken near Fort Bragg, California and Higgins (1919) reported four taken from a gill net near San Pedro. Clemens and Wilby (1946) give the range as extending from Southern California to northwest Alaska. They are said to attain a length of four feet and to be excellent eating. The present specimen is believed to extend the known southern limit of distribution about 200 miles.

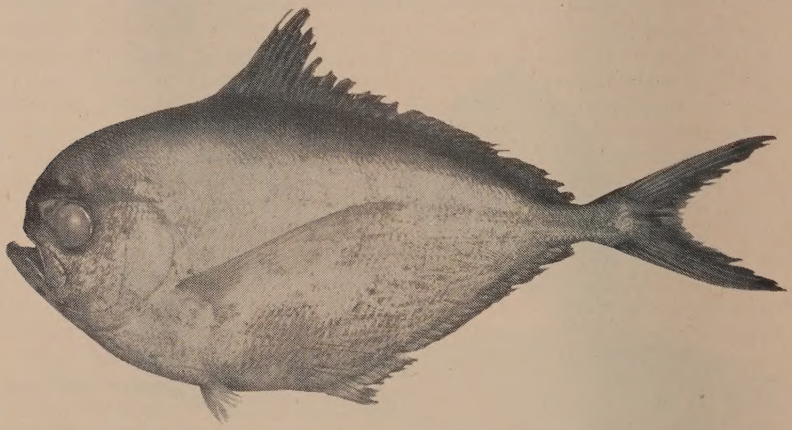

FIGURE 14. Pomfret. *Brama brama. Photograph by Al Johns for Vernon M. Haden, San Pedro*

FIGURE 15. Pacific Argentine. *Argentina sialis. Photograph by Al Johns for Vernon M. Haden, San Pedro*

CALIFORNIA WATERS

Argentina sialis Gilbert, Pacific argentine (Figure 15)

During the past year a considerable number of these supposedly rare fish have been collected along our coast. Most of them were killed by explosives used in offshore oil exploration, and were picked up by the official observer of the California Division of Fish and Game. A chronological list of the known occurrences of *Argentina sialis* follows:

1. 1889. Type specimen taken by the *Albatross* expedition off Cabo de Lobos, Sonora, Mexico.

2. December 9 and 10, 1919. Approximately 300 collected by the *Albacore* off Huntington Beach, California (Higgins, 1920).
3. April 14, 1941. One specimen taken in otter trawl by the *N. B. Scofield* 11 miles off Oceanside in 230-240 feet of water. Previously unrecorded.
4. April 15, 1941. Five specimens taken in otter trawl by the *N. B. Scofield* nine miles off Oceanside in 195-200 feet of water. Previously unrecorded.
5. 1941. Two specimens taken in otter trawl, Monterey Bay, California (Follett, 1945).
6. June 30, 1948. One adult killed by explosives six miles east of Gaviota, Santa Barbara County (Fitch, 1949a).
7. August 26, 1948. Two adults killed by explosives off Pt. Conception (Fitch, 1949a).
8. November, 1948. Over 1,000 pounds of *A. sialis* and *Spirinchus starksi* killed by explosives during the month between Pismo Beach and Point Arguello. A sample of this kill of "whitebait" contained nine *A. sialis* and three *S. starksi*.
9. December 9, 1948. Approximately 150 pounds killed by explosives one mile southwest of Pt. Arguello lighthouse. Three collected.
10. May 2, 1949. Estimated 40 pounds killed by explosives 7 to 10 miles southeast of Santa Barbara in 294 to 336 feet of water.
11. May 5, 1949. Estimated 240 pounds killed by explosives seven miles southeast of Santa Barbara in 282 to 342 feet of water.
12. May 12, 1949. Estimated five pounds killed by explosives four to five miles southeast of Santa Barbara. Four specimens collected.
13. May 17, 1949. 50 adults killed by explosives and collected off Santa Barbara (latitude 34° 21′ N., longitude 119° 34′ W.) in 137 feet of water.
14. May 20, 1949. 75 large adults killed by explosives and collected off Ventura (latitude 34° 12′ N., longitude 119° 31′ W.) in 269 feet of water.
15. June 28, 1949. 12 adults killed by explosives and collected off Santa Barbara (latitude 34° 20′ N., longitude 119° 34′ W.) in 190 feet of water.
16. June 29, 1949. 88 specimens killed by explosives and collected at the same locality as 15 above only in 129 feet of water.
17. June 30, 1949. Three adults taken from the stomach of a *Squalus suckleyi* caught in modified otter trawl off San Simeon in 420 to 480 feet of water. Collected on boat *Sebastian L* by Dr. Boyd W. Walker, Mr. A. O. Flechsig and Mr. A. B. Rechnitzer of the University of California at Los Angeles.
18. June 30, 1949. Three adults killed by explosives and collected off Santa Barbara (latitude 34° 20′ N., longitude 119° 42′ W.) in 250 to 300 feet of water.
19. July 11, 1949. Four very large adults killed by explosion and collected off Ventura (latitude 34° 10′ N., longitude 119° 38′ W.) in 708 to 840 feet of water.

About 10 of the argentines killed in seismic operations have been deposited at each of the following institutions:

Scripps Institution of Oceanography, La Jolla,
University of California at Los Angeles, and the
Stanford University Museum.

The remainder of the specimens collected are currently at the California State Fisheries Laboratory.

Counts and measurements were taken on 20 specimens and the following summation of the various counts is given in order to supplement the limited amount of data available on this species. Dorsal ii, 8 to ii 10; anal ii, 10 to ii, 12; pectoral 16 to 17; pelvics 10 to 11. Gill rakers counted on the outer arch 7 to 9 on the upper limb and 18 to 20 on the lower limb; total gill rakers 25 to 29. Scales along the lateral line 48 to 51. Vertebral counts on ten specimens 47 to 49 including the hypural plate (31 to 33 thoracic and 16 to 17 caudal).

All four argentines taken on July 11, 1949 exceeded the maximum standard length of 174 mm. recorded by Follett (1945). These four specimens were 176, 177, 182 and 195 mm. respectively. Two females had ripe gonads.

Ophichthus triserialis (Kaup), Spotted snake eel (Figure 16)

On April 15, 1949 Mr. John Puttman of Long Beach, California took a three and a half foot spotted snake eel on a set line near the Long Beach breakwater. Clark (1937) recorded a 36-inch female taken off San Pedro and stated that the species is found commonly from Lower California to the Galapagos Islands. Hubbs (1916a) recorded two specimens from off San Pedro and two from La Jolla. He also extended the northern known limit of distribution for this species to Tomales Bay, California.

During the spring of 1949 the author saw a thirty inch snake eel (*Ophichthus* sp.) on the exposed tidal flats at San Felipe, Lower California. It moved quite rapidly in a snake-like fashion across the firm mud flats, stopping its forward progress only long enough to reverse and commence digging into the mud tail first. In a matter of two or three seconds it was completely buried. It reappeared at the surface some five feet away and in the opposite direction from which it had dug in, traveling this distance through quite firm mud in not over ten seconds.

FIGURE 16. Spotted snake eel. *Ophichthus triserialis. Photograph by Al Johns for Vernon M. Haden, San Pedro*

Scomberomorus concolor (Lockington) Monterey Spanish mackerel

On July 9, 1949 Mr. William Bellinger of Alhambra caught a Monterey Spanish mackerel about 2⅓ feet long (603 mm. standard length) in Newport Harbor. Mr. Bellinger was fishing from a skiff and using live anchovies for bait. This represents the seventh known California record for this species since its disappearance in the 1880's.

S. concolor closely resembles *Scomberomorus sierra* which is found in considerable numbers along the coast of Lower California and Mexico. A comparison of the two species based upon 17 *S. sierra* and 30 *S. concolor* showed the following major points of variation. In *S. sierra* there were 183 to 201 scales along the lateral line while in *S. concolor* there were 152 to 165. Gill raker counts on the outer arch of *S. sierra* were 2 to 4 for the upper limb and 10 to 12 for the lower limb. *S. concolor* had 5 to 9 gill rakers on the upper limb and 15 to 20 on the lower. Most of the other counts and measurements for the two species showed considerable overlap. Vertebral counts for both species ranged from 47 to 49 (20 to 21 thoracic and 27 to 28 caudal). There are some slight differences between the crania of the two species, based on 2 *S. concolor* and 26 *S. sierra*. The gill raker and vertebral counts of the 26 *S. sierra* agree with those given by Eckles (1949) for several juvenile sierra.

Rhynchocymba catalinensis Wade, Conger (Figure 17)

On June 4, 1949 Mr. John Radovich, Bureau of Marine Fisheries observer aboard an oil survey boat, picked up two of these rare congers which had been killed by an underwater explosion. They were taken about two miles off the southeast end of Santa Rosa Island (latitude 34° 10′ N., longitude 120° 09′ W.) in some 230 feet of water. Previously it was known only from the type specimen taken off Santa Catalina Island (Wade, 1946). Due to the rarity of this species the following counts and measurements are presented. (All lengths are in millimeters).

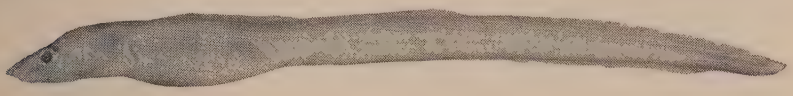

FIGURE 17. Conger. *Rhynchocymba catalinensis. Photograph by Al Johns for Vernon M. Haden, San Pedro*

	No. 1	*No. 2*	*Type*
Length	419	367	286
Head			48
To top of gill slit	69	58	
To bottom of gill slit	74	61	
Snout	20	16	13.1
Eye	13	12	9
Bony interorbital	3	2.7	2
Width of gill opening	13	9	6.1
Pectoral length	22	21	17
Snout to dorsal insertion	80	69	--
Snout to anal insertion	161	144	--

There are approximately 130 pores in the lateral lines of each specimen. Dorsal and anal ray counts agree with those given by Wade.

Otophidium scrippsi Hubbs, California cusk eel

Two California cusk eels were killed by explosives two miles off the southeast end of Santa Rosa Island June 6, 1949. They were floating on the surface and picked up by the writer. Another was killed in the same manner on May 17, 1949, and picked up by Radovich some 4½ miles south of Santa Barbara. Fitch (1949b) reported several taken in the vicinity of Pt. Arguello. The present specimens help fill in a few blank spots in the known distribution of this species.

Rathbunella sp., Ronquil

An adult ronquil possibly *R. hypoplecta* was sent to the California State Fisheries Laboratory by Mr. John Wilson of Avila. According to Barnhart (1936) *R. hypoplecta* was known only from two specimens which had been taken off the Santa Barbara islands. Members of this genus are possibly much more common than published records indicate. It is probably rare only because it is seldom taken by any of the methods or types of gear commonly employed in our present fisheries. The present specimen was about 9⅛ inches in total length.

Trachipterus rex-salmonorum Jordan and Gilbert, California ribbonfish (Figure 18)

Four California ribbonfish were taken in a sardine purse seine on the night of October 17, 1949, by the boat *Nancy Rose*. One was taken in one set and the other three in a second set. According to the skipper, Mr. Ben Fukuzaki, they were readily seen swimming within the net when the brailing light was turned on. All four were caught several miles off Pt. Dume, the northern point of Santa Monica Bay. These peculiar fish are found at not infrequent intervals but their occurrence is seldom reported. At least 10 specimens have been reported to the California State Fisheries Laboratory within the past two years but most of them have been badly mutilated, due to rough handling before being brought in.

Sette (1923) reported one from Monterey and suggested that the species probably underwent a differential rate of growth during its metamorphosis. Hubbs (1926) later elaborated upon this differential growth rate. Thompson (1919) reported that numerous young were taken by the *Albacore* in its work. Phillips (1932) recorded a 14-inch specimen from Monterey and stated that the species is known to attain a length of seven feet. Roedel (1938) recorded six specimens taken in the summer of 1938 of which five young were found in the stomach of a wolf fish *Alepisaurus aesculapius*.

FIGURE 18. California ribbonfish. *Trachipterus rex-salmonorum. Photograph by Al Johns for Vernon M. Haden, San Pedro*

Alosa sapidissima (Wilson), Shad

A four-pound shad was delivered in a load of sardines to a Terminal Island cannery on the morning of October 28, 1949. It had been taken the night before a few miles off Huntington Beach. Shad have been caught in Southern California waters on several former occasions and recorded by Daugherty (1946), Croker (1930) and Thompson (1919).

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DUCK BANDING AT TULARE LAKE[1]

By Donald D. McLean
Bureau Game Conservation
California Division of Fish and Game

From 1938 to 1944, inclusive, an annual outbreak of botulism (*Clostridium botulinum*, Type C) occurred in the Tulare Lake Basin of Kings and Kern Counties. These annual epidemics came each year following the heavy run-off from Kings, Kaweah, Tule and Kern rivers, tributary to the Tulare Lake Basin. The percentage of affected birds increased from 1938 to 1941 and then dropped off to a very low figure in 1944, disappearing almost entirely in 1945.

The estimated maximum population of ducks increased almost continually until 1943 and then dropped off slightly.

Table 1 indicates the annual dates of maximum population and the area affected by the botulism outbreaks, together with estimated duck losses and the number of birds retrieved in an effort to flush out the toxin.

Of the ducks visiting the area approximately 3 percent were lost. Of the total of 14,470 ducks picked up by the crews and taken to the various duck holding pens, 9,943 were banded with U. S. Fish and Wildlife Service bands and released. The returns from these birds as they have been reported to us from the various parts of North America, shot or otherwise, are the subject of this article.

The data obtained from the reported returns is classified in various ways in an effort to show a trend in the return from given numbers of banded birds over given periods of time. Much information was secured relative to the travels of ducks using the Pacific Flyway.

The total number of each species of duck banded and released each year is shown in Table 2.

Table 3 contains a summary of all ducks banded during this study listed by sexes. A number of these birds did not exhibit sufficient characteristics to permit sexing and these have been tabulated as unclassified.

The number of bands returned was 1,169 or 11.74 percent of the total number of birds banded. These returns through the 1948-49 waterfowl hunting season, presented in Table 4, indicate that mallards yielded the highest rate of return.

Table 5 presents a summary of the banded ducks returned from California as well as those returned from outside the State. This data is tabulated by year banded for each species. The more ducks banded of any species, the more likely is the possibility that birds will be recovered out of the State.

The returns by sexes of the various species banded in each year of the study are computed in Table 6. Table 7 is a compilation of year of return for the ducks banded during the various years of the study. While most returns occurred during the year of banding or the following year, recoveries were obtained on three pintails eight years after banding. This is further exemplified in Table 8, and is expressed by percentage in Table 9.

[1] Submitted for publication January, 1950.

This material is further analyzed by returns on males and females for the various species in Tables 10 through 20.

Figures 19-23 illustrate the California recoveries of the various species of birds banded and recovered during the *same* year for the entire study period.

No shovellers or mallards banded at Tulare Lake were returned from outside of California.

Figures 24-28 are spot maps of the total recoveries through 1948 of the various species of ducks banded at Tulare Lake during the years 1939-1944. The recoveries outside of California are depicted in Figure 29. The return maps seem to indicate that the winter population of ducks in the San Joaquin Valley is, at least in part, separate from the Sacramento Valley population. The south end of the San Joaquin Valley appears to be a terminal area of a migration route. It seems to stop here and not extend into southern California or into Mexico. There was considerable movement of waterfowl from Tulare Lake to the Suisun marshes, the Delta region and the north San Joaquin Valley waterfowl areas.

A complete listing of all recoveries is presented in Tables 21 and 22.

TABLE 1

Ducks Retrieved at Tulare Lake Compared With Populations During Botulism Outbreaks, 1938-1945

Date of maximum population	(Estimated) total ducks	(Estimated) duck losses	Square miles affected	Ducks retrieved
10/15/38	100,000	20,000	50	1,391
10/20/39	250,000	60,000	45	1,392
9/ 1/40	600,000	150,000	70	5,158
9/15/41	2,000,000	250,000	125	5,671
10/ 8/42	3,500,000	25,000	40	461
10/10/43	4,000,000	30,000	20	576
9/29/44	3,500,000	1,000	20	91
9/25/45	3,000,000			
Totals	16,950,000	536,000	370	14,740

TABLE 2

Total Duck Banding at Tulare Lake

	1939	1940	1941	1942	1943	1944	Total
Fulvous tree duck (*Dendrocygna bicolor*)			3			2	5
Mallard (*Anas platyrhynchos*)	12	52	111	33	9	4	221
Cinnamon teal (*Anas cyanoptera*)	33	56	54	5	4	1	153
Blue-winged teal (*Anas discors*)	1			1			2
Green-winged teal (*Anas carolinensis*)	477	829	529	91	99	30	2,055
Pintail (*Anas acuta*)	260	1,872	4,006	210	345	47	6,740
Baldpate (*Mareca americana*)	2	8	1				11
Gadwall (*Chaulelasmus streperus*)	1	4					5
Shoveller (*Spatula clypeata*)	62	326	256	48	25		717
Redhead duck (*Nyroca americana*)		3	5		1	6	15
Ruddy duck (*Erismatura jamaicensis*)	7	8	3			1	19

TABLE 3

Sex Ratios of Ducks Banded at Tulare Lake, 1939-1944

	1939			1940			1941			1942		
	Male	Female	Unclassified	Male	Female	Unclassified	Male	Female	Unclassified	Male	Female	Unclassified
Fulvous tree duck									3			
Mallard	6	6		24	28		63	48		24	9	
Cinnamon teal	11	22		21	35		18	36		3	2	
Blue-winged teal	1										1	
Green-winged teal	325	152		652	177		384	144	1	79	12	
Pintail	117	143		909	963		2,080	1,925	1	124	86	
Baldpate	1	1		5	3		1					
Gadwall		1		1	3							
Shoveller	37	25		197	128	1	154	102		33	15	
Redhead duck				1		2		4	1			
Ruddy duck		2	5	2	1	5	2	1				

TABLE 3—Continued

Sex Ratios of Ducks Banded at Tulare Lake, 1939-1944

	1943			1944			Total males	Total females	Total unclassified	Total birds	Percent males	Percent females	Percent unclassified
	Male	Female	Unclassified	Male	Female	Unclassified							
Fulvous tree duck						2			5	5			100
Mallard	8	1		1	1	2	126	93	2	221	57.0	43.0	
Cinnamon teal	1	3		1			55	98		153	36.0	64.0	
Blue-winged teal							1	1		2	50.0	50.0	
Green-winged teal	85	14		19	11		1,544	510	1	2,055	75.1	24.9	
Pintail	231	114		26	21		3,487	3,252	1	6,740	51.7	48.3	
Baldpate							7	4		11	63.7	36.3	
Gadwall							1	4		5	20.0	80.0	
Shoveller	17	8					438	278	1	717	61.1	38.9	
Redhead duck	1			3		3	5	4	6	15	33.3	26.7	40.0
Ruddy duck					1		4	5	10	19	21.1	26.3	52.6
Totals							5,668	4,249	26	9,943	57.0	42.8	.2

TABLE 4

Total Returns Through 1948-49 Season

	Males			Females			Total		
	Banded	Returned	Percent returned	Banded	Returned	Percent returned	Banded	Returned	Percent returned
Fulvous tree duck							5		
Mallard	126	20	15.8	93	18	19.3	221	38	17.6
Cinnamon teal	55	4	7.2	98	4	4.0	153	8	5.2
Blue-winged teal	1			1			2		
Green-winged teal	1,544	142	9.9	510	50	9.8	2,055	192	8.9
Pintail	3,487	475	13.6	3,252	378	11.5	6,740	853	12.6
Baldpate	7	1		4			11	1	8.6
Gadwall	1			4			5		
Shoveller	438	52	12.1	278	25	9.0	717	77	10.7
Redhead duck	5			4			15		
Ruddy duck	4			5			19		

TABLE 5

Returns of Ducks Banded in Each Year, 1939-1944

	Returns of Ducks Banded in 1939				Returns of Ducks Banded in 1940				Returns of Ducks Banded in 1941			
	Number banded	California returns	Out-of state returns	Total returns	Number banded	California returns	Out-of state returns	Total returns	Number banded	California returns	Out-of state returns	Total returns
Fulvous tree duck									3			
Mallard	12				52	3		3	111	28		28
Cinnamon teal	33				56	4		4	54	3		3
Blue-winged teal	1											
Green-winged teal	477	31	4	35	829	88	3	91	529	48	1	49
Pintail	260	16	1	17	1,872	227	18	245	4,006	475	47	522
Baldpate	2				1	1		1	1			
Gadwall	1				4							
Shoveller	62	1		1	326	39		39	256	30		30
Redhead duck					3				5			
Ruddy duck	7				8				3			

TABLE 5—Continued

Returns of Ducks Banded in Each Year, 1939-1944

	Returns of Ducks Banded in 1942				Returns of Ducks Banded in 1943				Returns of Ducks Banded in 1944			
	Number banded	California returns	Out-of state returns	Total returns	Number banded	California returns	Out-of state returns	Total returns	Number banded	California returns	Out-of state returns	Total returns
Fulvous tree duck									2			
Mallard	33	5		5	9	2		2	4			
Cinnamon teal	5	1		1	4				1			
Blue-winged teal	1											
Green-winged teal	91	10	1	11	99	6		6	30			
Pintail	210	32	1	33	345	31	5	36	47			
Baldpate												
Gadwall												
Shoveller	48	4		4	25	3		3				
Redhead duck					1				6			
Ruddy duck									1			

TABLE 6

Returns by Sexes of Ducks Banded in Each Year, 1939-1943

	Mallard	Cinnamon teal	Green-winged teal	Pintail	Baldpate	Shoveller
1939						
Percent males banded	50.0	33.3	68.1	45.0	50.0	59.7
Percent males returned	----------	----------	68.0	41.0	----------	----------
Percent females banded	50.0	66.6	31.9	55.0	50.0	40.3
Percent females returned	----------	----------	31.0	58.0	----------	100.0
Total returned	----------	----------	35	17	----------	1
1940						
Percent males banded	46.2	37.5	78.6	48.6	63.7	60.4
Percent males returned	----------	50.0	71.0	48.0	100.0	64.0
Percent females banded	53.8	62.5	21.4	51.4	36.3	39.3
Percent females returned	100.0	50.0	28.0	51.0	----------	35.0
Total returned	3	4	91	245	1	39
1941						
Percent males banded	56.8	33.3	72.6	51.9	100.0	60.2
Percent males returned	53.0	33.0	75.0	57.0	----------	76.0
Percent females banded	43.2	66.6	27.2	48.1	----------	39.8
Percent females returned	46.0	66.0	24.0	42.0	----------	23.0
Total returned	28	3	49	521	----------	30
1942						
Percent males banded	72.7	60.0	86.8	59.0	----------	68.8
Percent males returned	60.0	100.0	90.0	55.0	----------	50.0
Percent females banded	27.3	40.0	13.2	41.0	----------	31.2
Percent females returned	40.0	----------	9.0	44.0	----------	50.0
Total returned	5	1	11	34	----------	4
1943						
Percent males banded	88.9	25.0	85.9	67.0	----------	68.0
Percent males returned	100.0	----------	100.0	83.0	----------	66.0
Percent females banded	11.1	75.0	14.1	33.0	----------	32.0
Percent females returned	----------	----------	----------	16.0	----------	33.0
Total returned	2	----------	6	36	----------	3

TABLE 7

Returns Showing the Year Banded and Year Returned

Number banded	Year banded	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
Pintail												
260	1939	7	4		3	1	2					17
1,872	1940		133	45	16	16	16	10	7	2		245
4,006	1941			333	66	53	33	17	12	7	1	522
210	1942				20	6	4	1	2			33
345	1943					27	3	1	4	1		36
6,693		7	137	378	105	103	58	29	25	10	1	853
Green-winged teal												
477	1939	14	13	4	3		1					35
829	1940		61	21	5	3	1					91
529	1941			31	12	1	5					49
91	1942				4	4	3					11
99	1943					5			1			6
2,025		14	74	56	24	13	10		1		1	192
Shoveller												
62	1939	1										1
326	1940		34	2	1	2						39
256	1941			22	2	4	2					30
48	1942				4							4
25	1943					2	1					3
717		1	34	24	7	8	3					77
Mallard												
52	1940		2	1								3
111	1941			17	5	2	3		1			28
33	1942				3	2						5
9	1943						1	1				2
205			2	18	8	4	4	1	1			38
Cinnamon teal												
56	1940		4									4
54	1941			2	1							3
5	1942				1							1
115			4	2	2							8
Baldpate												
1	1940			1								1
1				1								1

TABLE 8

Returns of Ducks by Years of Elapsed Time

Year	Total banded	First year	Second year	Third year	Fourth year	Fifth year	Sixth year	Seventh year	Eighth year	Total
1939	855	22	17	4	6	1	3			53
1940	3,158	234	70	22	21	17	10	7	2	383
1941	4,968	405	86	60	43	17	13	7	1	632
1492	388	32	12	7	1	2				54
1943	483	34	5	2	5	1				47
1944	91									
Totals	9,943	727	190	95	76	38	26	14	3	1,169

TABLE 9

Percentage of Total Returns Reported Each Year

Year banded	Total Return	Percent First year	Percent Second year	Percent Third year	Percent Fourth year	Percent Fifth year	Percent Sixth year	Percent Seventh year	Percent Eighth year
1939	53	41.5	32.1	7.5	11.3	1.9	5.7		
1940	383	61.1	18.3	5.7	5.5	4.6	2.7	1.8	.5
1941	632	64.1	13.6	9.5	6.8	2.7	2.1	1.1	.2
1942	54	59.3	22.2	13.0	1.9	3.7			
1943	47	72.3	10.6	4.3	10.6	2.1			

TABLE 10

Year Banded and Year Returned of Male Pintail

Year banded	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
1939	3	1			1	2					7
1940		60	22	10	8	7	6	5	1		119
1941			190	31	34	23	11	8	4		301
1942				11	3	2	1	2			19
1943					23	3	1	3			30
Totals	3	61	212	52	69	37	19	18	5		476

TABLE 11

Year Banded and Year Returned of Female Pintail

Year banded	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
1939	4	3		3							10
1940		73	23	6	8	9	4	2	1		126
1941			142	35	19	11	5	4	3	1	220
1942				10	3	2					15
1943					4			1	1		6
Totals	4	76	165	54	34	22	9	7	5	1	377

TABLE 12

Year Banded and Year Returned of Male Green-winged Teal

Year banded	1939	1940	1941	1942	1943	1947	1945	1946	1947	1948	Total
1939	10	9	3	1		1					24
1940		43	15	4	2	1					65
1941			20	12	1	4					37
1942				3	4	3					10
1943					5			1			6
Totals	10	52	38	20	12	9		1			142

TABLE 13

Year Banded and Year Returned of Female Green-winged Teal

Year banded	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
1939	4	4	1	2							11
1940		18	6	1	1						26
1941			11			1					12
1942				1							1
1943											
Totals	4	22	18	4	1	1					50

TABLE 14

Year Banded and Year Returned of Male Shoveller

Year banded	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
1939											
1940		22	2	1							25
1941			17	2	2	2					23
1942				2							2
1943					1	1					2
Totals		22	19	5	3	3					52

TABLE 15

Year Banded and Year Returned of Female Shoveller

Year banded	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
1939	1										1
1940		12			2						14
1941			4	1	2						7
1942				2							2
1943					1						1
Totals	1	12	4	3	5						25

TABLE 16

Year Banded and Year Returned of Male Mallard

Year banded	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
1940											
1941			7	3	2	3					15
1942				1	2						3
1943						1		1			2
Totals			7	4	4	4		1			20

TABLE 17

Year Banded and Year Returned of Female Mallard

Year banded	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
1940		2	1								3
1941			10	2				1			13
1942				2							2
1943											
Totals		2	11	4				1			18

TABLE 18

Year Banded and Year Returned of Male Cinnamon Teal

Year banded	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
1940		2									2
1941			1								1
1942				1							1
Totals		2	1	1							4

TABLE 19

Year Banded and Year Returned of Female Cinnamon Teal

Year banded	1939	1940	1941	1942	Total
1940		2			2
1941			1	1	2
1942					
Totals		2	1	1	4

TABLE 20

Year Banded and Year Returned of Male Baldpate

Year banded	1940	1941	Total
1940		1	1
Totals		1	1

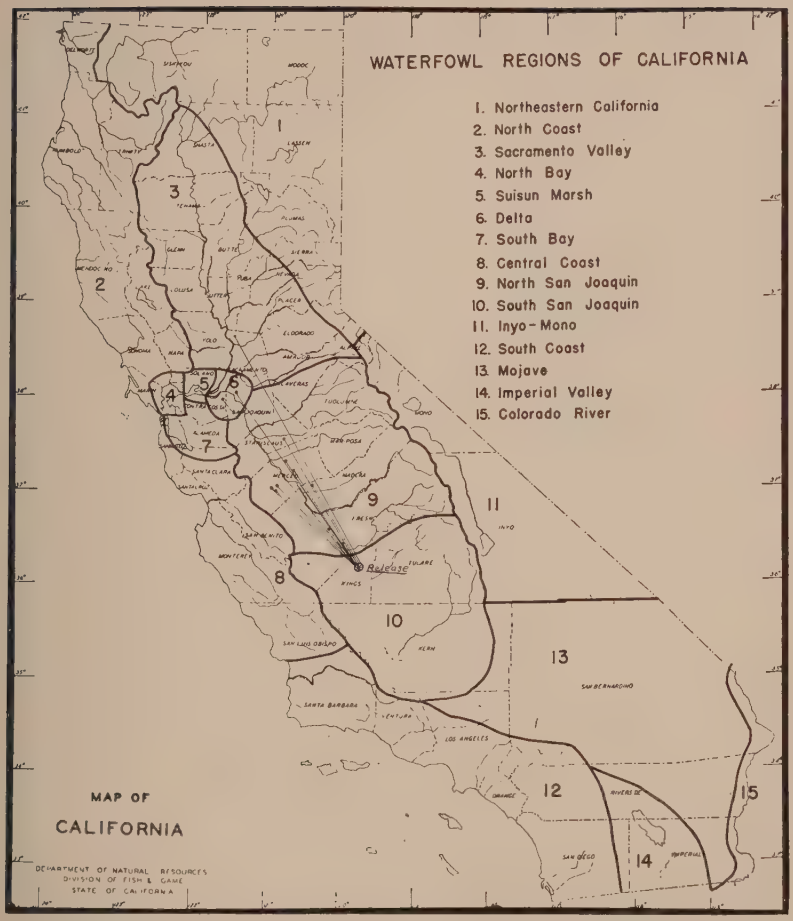

FIGURE 19. Returns of mallards during the year of banding. Locals not shown

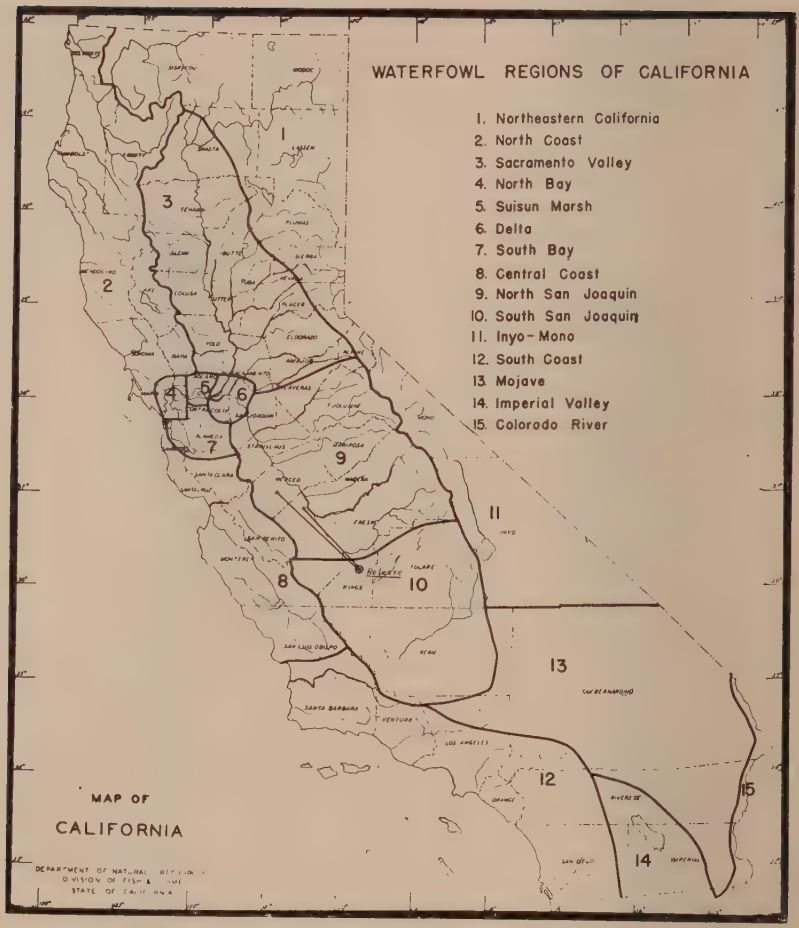

FIGURE 20. Returns of cinnamon teal. Locals not shown

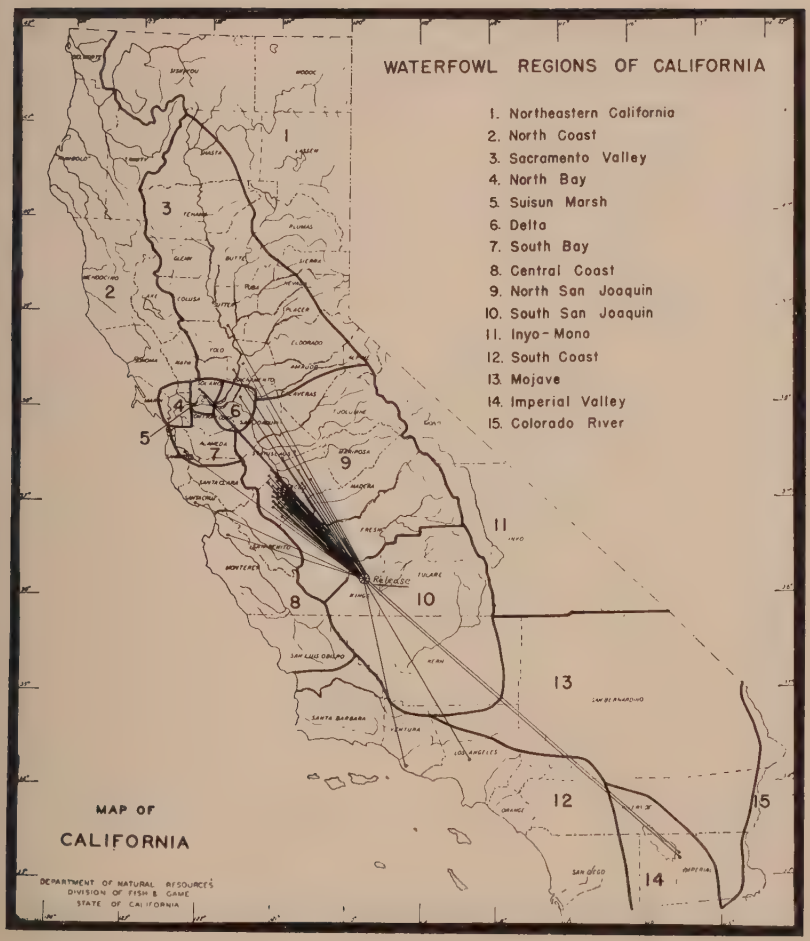

FIGURE 21. Returns of green-winged teal during the year of banding. Locals not shown

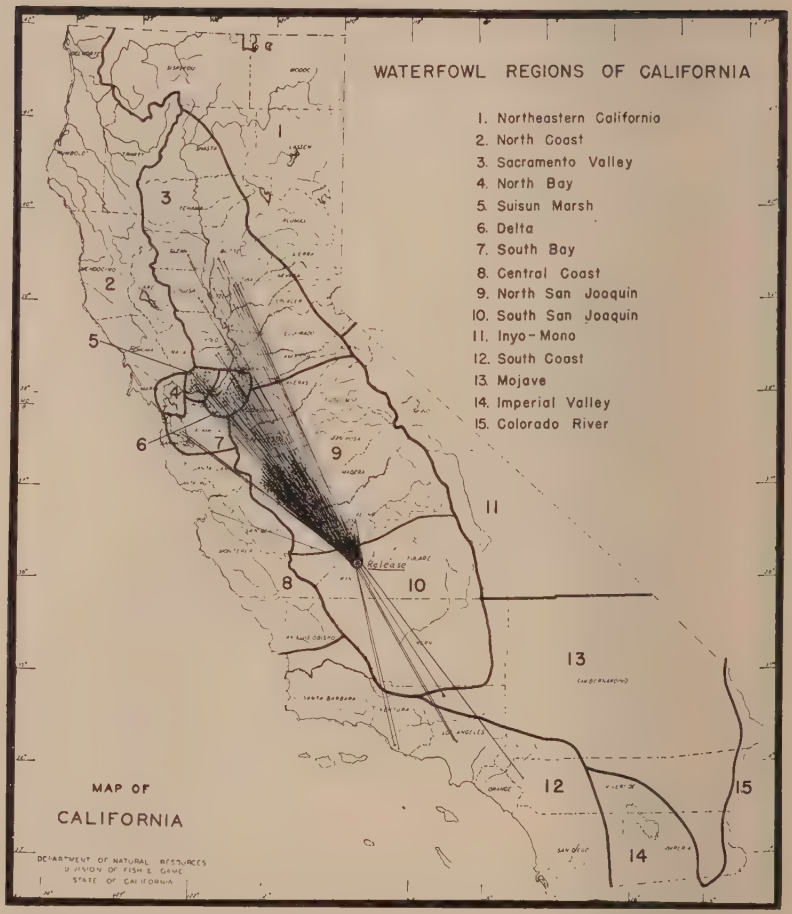

FIGURE 22. Returns of pintail ducks during the year of banding. Locals not shown

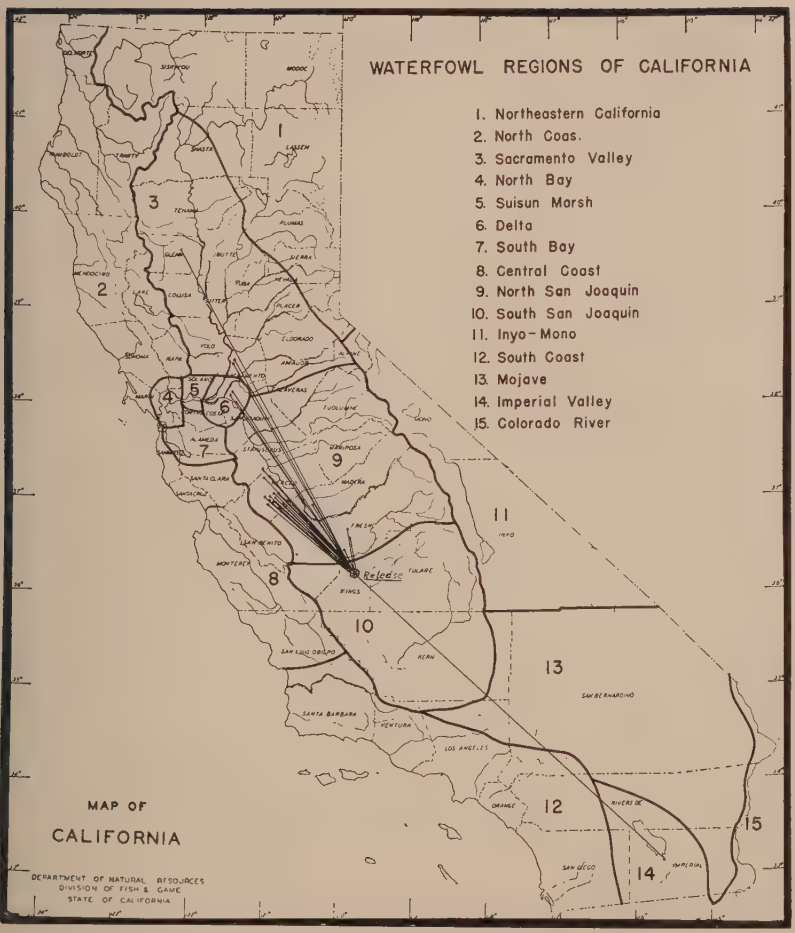

FIGURE 23. Returns of shovellers during the year of banding. Locals not shown

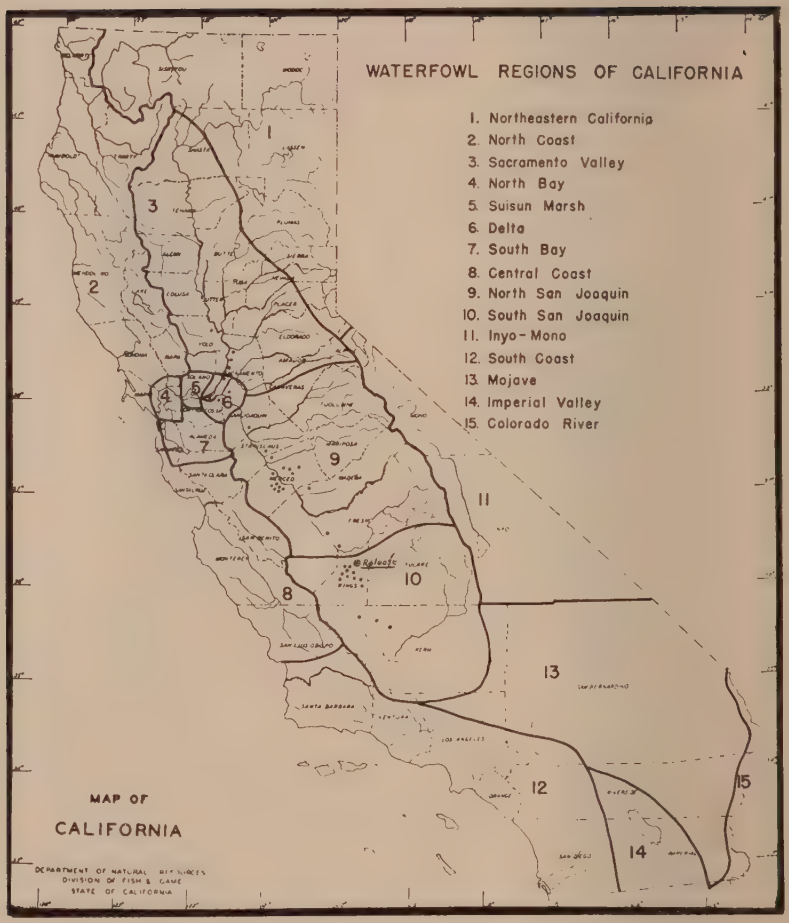

FIGURE 24. Total mallard returns

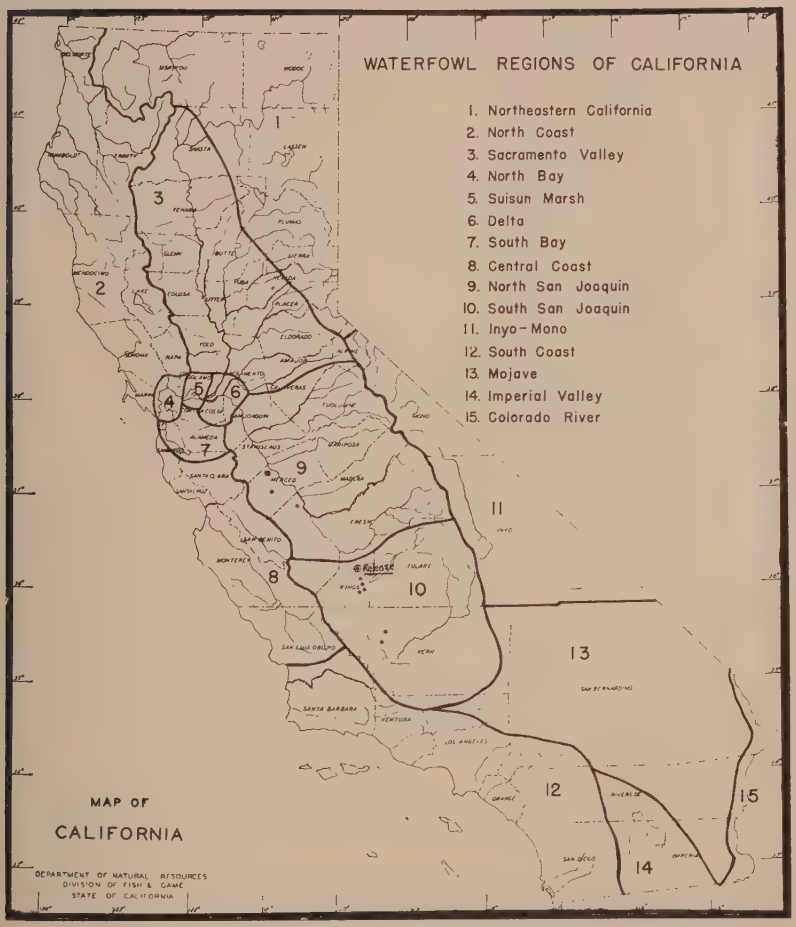

FIGURE 25. Total cinnamon teal and baldpate returns. Teal indicated by dots, baldpate shown as a square

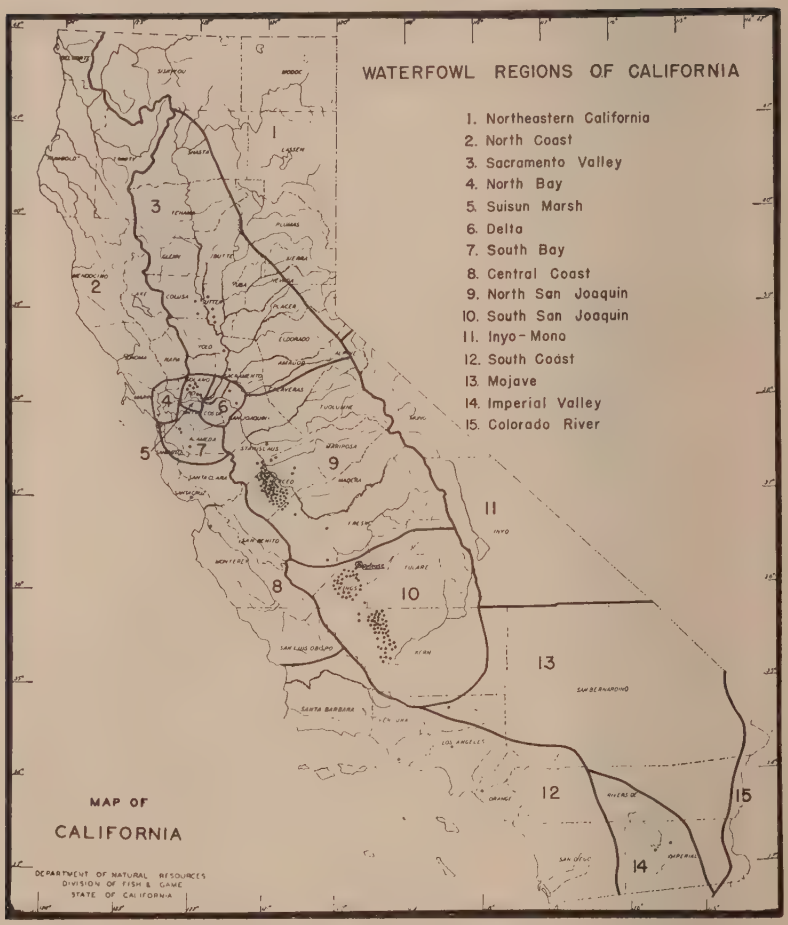

FIGURE 26. Total green-winged teal returns

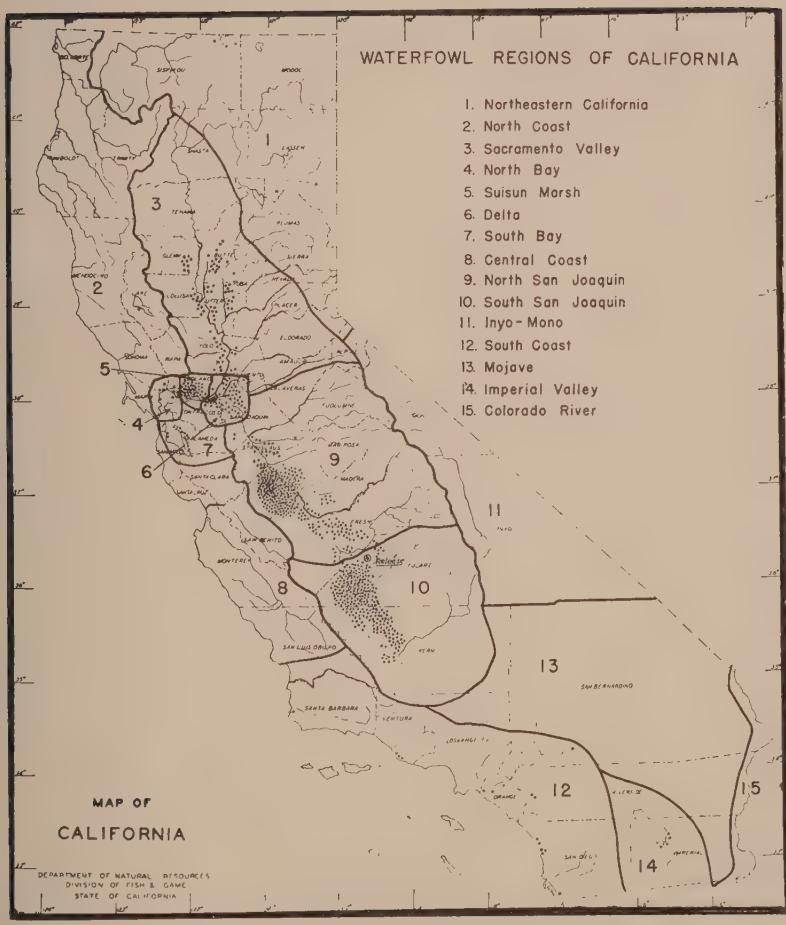

FIGURE 27. Total pintail returns

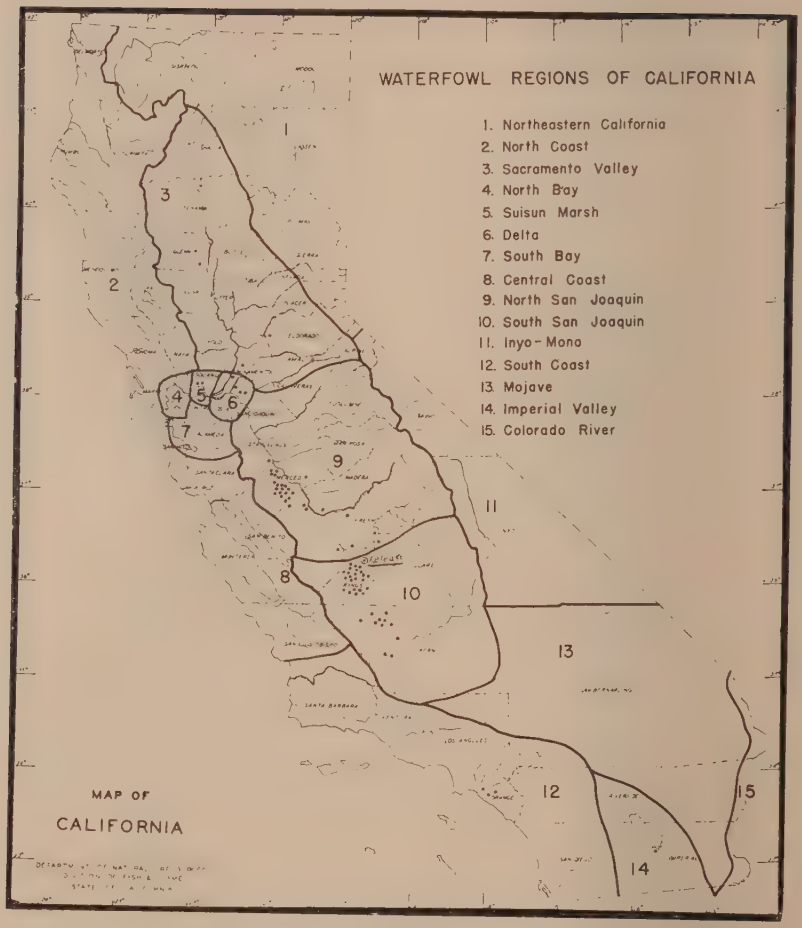

FIGURE 28. Total shoveler returns

TABLE 21

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF GREEN-WINGED TEAL

Region of return	Date of banding	Place of return	Date of return
Banded in 1939			
Male			
Sacramento Valley	10/24/39	Sutter Co.	10/16/40
Suisun	11/ 6/39	Solano Co.	Season 1940
	10/24/39	Simmons Island, Solano Co.	12/18/44
South Bay	10/20/39	Near Oakland	11/24/40
North San Joaquin	10/14/39	Los Banos	11/19/39
	10/20/39	Los Banos	12/ 3/39
	10/24/39	Los Banos	12/ 6/39
	10/27/39	Gustine	12/ 3/39
	10/15/39	Gustine	11/ 7/40
	10/24/39	South Dos Palos	12/14/40
	10/24/39	Newman	10/16/40
	11/ 7/39	Los Banos	12/ 7/41
	10/24/39	Los Banos	12/ 6/42
South San Joaquin	9/14/39	Tulare Lake	10/25/39
	9/14/39	10 mi. W. of Delano	10/29/39
	10/15/39	Delano	11/26/39
	10/15/39	Tulare Lake	11/12/39
	10/20/39	Tulare Lake	10/20/39
	10/24/39	Corcoran	12/ 3/39
	10/ 3/39	85 mi. N. of Buena Vista Lake	10/27/40
	11/ 6/39	Pond	10/20/40
	10/ 3/39	Tulare Lake	11/29/41
Female			
Sacramento Valley	10/24/39	Sutter Co.	12/19/40
North San Joaquin	10/18/39	5 mi. E. of Los Banos	11/ 5/39
	10/24/39	Newman	12/ 3/39
	10/15/39	Los Banos	11/17/40
South San Joaquin	10/20/39	Bakersfield	11/ 5/39
	10/27/39	Wasco	11/26/39
	10/15/39	Bakersfield	November 1940
	10/27/39	Bakersfield	11/17/40
	8/22/39	Pond	10/21/41
Banded in 1940			
Male			
Sacramento Valley	9/22/40	Knight's Landing	12/ 8/40
	10/ 8/40	Colusa Outing Club	10/15/42
Delta	10/ 8/40	Lodi	12/11/40
Suisun	9/21/40	Fairfield	10/27/40
	10/ 8/40	Suisun Bay	12/ 4/40
	9/ 7/40	Fairfield	10/ 3/43
South Bay	9/21/40	Near San Francisco	11/24/40
	9/ 4/40	Irvington	10/ 2/42
North San Joaquin	9/ 4/40	Los Banos	11/10/40
	9/21/40	Turlock	11/ 3/40
	10/ 8/40	Livingston	11/27/40
	10/ 8/40	Los Banos	12/11/40
	10/ 8/40	Los Banos	11/30/40
	10/ 8/40	Los Banos	12/16/40
	10/ 8/40	Los Banos	12/14/40
	10/ 8/40	Western Merced Co.	12/30/40
	10/17/40	Los Banos	12/14/40
	10/24/40	Los Banos	11/24/40
	9/22/40	Los Banos	11/ 9/41
	10/ 8/40	Los Banos	10/16/41
	10/ 8/40	Los Banos	October 1941
	10/ 9/40	Gustine	10/26/41
	10/ 9/40	Madera Co.	November 1941
	10/ 8/40	5 mi. NE. of Gustine	10/ 1/42
	9/ 4/40	Los Banos	12/10/44
South San Joaquin	8/30/40	Wasco	11/15/40
	8/31/40	Buena Vista Lake	11/ 7/40
	9/ 5/40	Delano	11/14/40
	9/ 5/40	Beverly Gun Club, Kern Co.	11/ 3/40
	9/ 7/40	Lost Lake Slough	11/ 6/40

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF GREEN-WINGED TEAL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1940—Continued			
Male—Continued			
South San Joaquin—Continued	9/ 7/40	Tulare Lake	10/19/40
	9/ 7/40	Wasco	10/27/40
	9/ 7/40	Delano	11/17/40
	9/21/40	Kings Co.	Season 1940
	9/21/40	Wasco	10/27/40
	9/22/40	Kern Co.	11/23/40
	9/26/40	Bakersfield	11/15/40
	9/25/40	Wasco	11/10/40
	9/25/40	Kings Co.	Season 1940
	10/ 8/40	Near Coalinga	10/30/40
	10/ 8/40	Wasco	11/25/40
	10/ 8/40	Wasco	12/14/40
	10/ 8/40	Los Patos Duck Club, Pond	11/ 5/40
	10/ 8/40	Buena Vista Lake	11/ 7/40
	10/ 8/40	Buttonwillow	12/ 7/40
	10/ 8/40	Lost Hills	11/10/40
	10/ 9/40	Tulare Lake	12/ 8/40
	10/14/40	Beverly Gun Club, Kern Co. Road	12/ 1/40
	10/14/40	Stratford	11/ 8/40
	10/17/40	Wasco	12/ 1/40
	10/24/40	Kern Co.	12/ 1/40
	10/ 8/40	Tulare Lake	December 1941
	10/ 8/40	Wasco	10/26/41
	10/ 8/40	Near Bakersfield	December 1941
	10/ 8/40	Alpaugh	10/19/41
	10/14/40	Near Bakersfield	11/11/41
	10/14/40	Tulare Lake	December 1941
	10/14/40	Pond	10/ 2/41
	10/17/40	Tulare Lake	December 1941
	10/24/40	Tulare Lake	December 1941
South Coast	9/13/40	North Hollywood	11/24/40
Imperial	9/ 4/40	Salton Sea	10/25/40
Female			
Sacramento	9/26/40	Near Sacramento	11/20/40
Central Coast	9/25/40	Spreckels, Monterey Co.	10/27/40
	10/ 9/40	Near Santa Cruz	12/ 4/40
North San Joaquin	9/ 7/40	Los Banos	11/24/40
	9/22/40	Brito, near Dos Palos	11/10/40
	9/25/40	Los Banos	11/24/40
	10/ 8/40	Merced	12/14/40
	10/ 8/40	Los Banos	11/17/40
	10/10/40	Los Banos	12/22/40
	10/14/40	Dos Palos	12/ 2/40
	9/26/40	Los Banos	11/24/40
	10/ 8/40	Los Banos	11/16/41
	9/ 4/40	9 mi. S. of Los Banos	10/24/43
South San Joaquin	8/31/40	Tulare Lake	Season 1940
	9/ 7/40	Tulare Lake	10/27/40
	9/13/40	Tulare Lake	Season 1940
	9/21/40	Pond	12/ 1/40
	10/ 8/40	25 mi. NW. of Wasco	11/10/40
	10/ 8/40	Kern Co.	11/ 9/40
	10/ 8/40	Near Bakersfield	12/14/40
	9/21/40	Pond	10/18/40
	9/22/40	Tulare Lake	10/20/41
	9/25/40	Tulare Lake	December 1941
	10/ 8/40	Tulare Lake	December 1941
	10/17/40	Tulare Lake	December 1941
Mojave Desert	9/13/40	Lancaster	11/22/42
Banded in 1941			
Male			
Sacramento	10/14/41	Sutter Co.	10/15/42
Suisun	9/22/41	Solano Co.	1/ 5/43
	10/ 1/41	Simmons Island, Solano Co.	12/18/44
North San Joaquin	9/ 9/41	Salt Slough, Merced Co.	10/26/41
	9/15/41	10 mi. SW. of Merced	12/ 3/41
	9/20/41	Newman	11/ 5/41

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF GREEN-WINGED TEAL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Male—Continued			
North San Joaquin—Continued	9/22/41	Gustine	11/ 5/41
	10/ 1/41	Kerman	12/ 7/41
	10/13/41	Los Banos	11/10/41
	10/13/41	Dos Palos	12/13/42
	9/ 9/41	5 mi. E. of Gustine	12/23/42
	9/15/41	Los Banos	11/17/42
	9/15/41	Gustine	12/23/42
	9/20/41	Gustine	10/15/42
	10/13/41	Gustine	12/12/42
	10/ 1/41	Los Banos	12/13/42
	10/ 1/41	10 mi. SW. of Gustine	11/18/42
	9/25/41	Los Banos	11/28/43
	9/15/41	Crow's Landing	November 1944
	9/22/41	Gustine	12/ 6/44
	9/25/41	Los Banos	11/15/44
South San Joaquin	10/14/41	Tulare Lake	December 1941
	10/14/41	Tulare Lake	December 1941
	9/ 9/41	Delano	Fall, 1941
	9/13/41	Buttonwillow	October 1941
	9/15/41	Delano	11/ 2/41
	9/15/41	Near Bakersfield	10/26/41
	9/20/41	Pond	11/ 1/41
	9/20/41	Near Bakersfield	10/26/41
	9/25/41	Pond	11/ 7/41
	9/25/41	Pond	12/ 7/41
	9/29/41	Kern County	10/17/41
	10/13/41	Tulare Lake	11/12/41
	10/ 1/41	Tulare Lake	Season 1942
South Coast	9/15/41	Oxnard	11/ 6/41
Imperial	9/ 9/41	Calipatria	11/15/41
Female			
Sacramento	10/ 9/41	Williams	11/ 5/44
	9/ 9/41	Yolo County	December 1941
Delta	9/ 9/41	20 mi. NW. of Stockton	12/ 7/41
Suisun	9/ 9/41	Solano County	December 1941
North San Joaquin	9/15/41	Gustine	12/ 7/41
	10/ 1/41	Los Banos	11/23/41
	10/13/41	Modesto	Fall, 1941
	10/ 1/41	Los Banos	11/23/41
South San Joaquin	10/14/41	Tulare Lake	December 1941
	10/14/41	Delano	Fall, 1941
	9/15/41	Pond	11/ 2/41
	9/20/41	Tulare Lake	10/25/41
Banded in 1942			
Male			
Suisun	10/16/42	Suisun	11/10/43
North San Joaquin	10/10/42	Los Banos	12/ 4/42
	10/10/42	Newman	12/15/43
	10/16/42	Los Banos	12/20/43
	10/16/42	Gustine	12/ 3/44
	10/16/42	Los Banos	11/22/44
South San Joaquin	10/16/42	Tulare Lake	Season 1942
	10/16/42	South of Bakersfield	11/18/42
South Coast	10/16/42	Near Los Angeles	11/22/43
Female			
South San Joaquin	10/16/42	Tulare Lake	Season 1942
Banded in 1943			
Male			
North San Joaquin	10/16/43	Los Banos	11/ 7/43
	10/16/43	Los Banos	12/22/43
	10/16/43	Los Banos	10/27/43
	10/16/43	Firebaugh	October, 1943
	10/16/43	Los Banos	10/31/43
	10/16/43	Gustine	3/ 9/46

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF SHOVELLERS

Region of return	Date of banding	Place of return	Date of return
Banded in 1939			
Female			
North San Joaquin	10/18/39	Los Banos	12/ 4/39
Banded in 1940			
Male			
Sacramento Valley	9/ 7/40	Sacramento	Season 1940
Delta	8/29/40	Stockton	11/18/40
North San Joaquin	8/31/40	Los Banos	11/ 6/40
	8/31/40	Gustine	11/ 6/40
	9/ 5/40	Riverdale	10/20/40
	9/22/40	Near Fresno	11/ 3/40
	10/14/40	Los Banos	12/14/40
South San Joaquin	8/31/40	Tulare Lake	Season 1940
	10/ 4/40	Tulare Lake	Fall, 1940
	9/13/40	Tulare Lake	Season 1940
	9/21/40	Kings County	Season 1940
	9/26/40	Stratford	11/ 3/40
	10/ 8/40	Kings County	Season 1940
	10/ 8/40	Tulare Lake	Fall, 1940
	10/ 8/40	Tulare Lake	Fall, 1940
	10/ 8/40	Kings County	Fall, 1940
	10/ 8/40	Lost Hills	11/ 6/40
	10/ 8/40	Near Coalinga	10/21/40
	10/ 8/40	Near Bakersfield	December 1940
	10/10/40	Wasco	11/ 3/40
	10/17/40	Kings County	Season 1940
	10/ 4/40	Pond	12/ 7/41
	10/ 8/40	Near Bakersfield	10/ 8/42
South Coast	10/ 8/40	Orange County	12/13/41
Female			
Suisun	10/ 8/40	Suisun Marsh	12/ 8/43
North San Joaquin	8/31/40	Merced County	10/16/40
	8/31/40	Dos Palos	11/17/40
	9/25/40	Mendota	11/ 1/40
	9/26/40	Los Banos	11/24/40
	10/ 8/40	18 mi. W. of Madera	11/24/40
South San Joaquin	8/31/40	MacFarland	11/ 3/40
	8/31/40	Kings County	Season 1940
	9/21/40	Tulare Lake	12/ 7/40
	10/ 8/40	Tulare Lake	12/15/40
	10/ 8/40	Pond	11/13/40
	10/14/40	Tulare Lake	12/10/40
	10/17/40	Kings County	Season 1940
South Coast	10/17/40	Santa Ana	December 1943
Banded in 1941			
Male			
Delta	9/25/41	North of Stockton	11/28/41
North San Joaquin	9/20/41	12 mi. S. of Fresno	12/14/41
	10/ 1/41	Firebaugh	12/16/41
	10/ 1/41	Newman	11/30/41
	9/25/41	Los Banos	11/16/41
	10/ 1/41	Dos Palos	10/29/41
	10/ 9/41	Gustine	11/30/41
	10/13/41	Los Banos	12/ 7/41
	10/13/41	Dos Palos	11/20/41
	10/13/41	Mud Slough near Gustine	12/19/42
	9/15/41	Los Banos	1/30/43
	10/ 9/41	Los Banos	12/23/44
	10/ 7/41	7 mi. W. of Fresno	12/10/44
South San Joaquin	10/14/41	Tulare Lake	10/18/41
	10/ 1/41	Tulare Lake	December 1941
	9/25/41	Maricopa	11/19/41
	9/25/41	Tulare Lake	December 1941
	10/ 1/41	Buena Vista Lake	12/10/41
	10/ 7/41	Pond	11/23/41
	10/13/41	Kern County	12/ 3/41
	10/18/41	Near Kettleman City	February 1942

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF SHOVELLERS—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Male—Continued			
South Coast	10/ 1/41	Near Long Beach	November 1943
Imperial	9/25/41	Westmorland	11/11/41
Female			
Sacramento	10/ 7/41	Near Placerville	11/ 6/43
Delta	9/25/41	10 mi. W. of Lodi	12/10/41
North San Joaquin	9/ 9/41	Los Banos	10/29/41
	10/ 1/41	Gustine	11/15 or 11/22/42
	9/13/41	Los Banos	12/27/43
South San Joaquin	9/20/41	Hanford	10/29/41
	10/ 1/41	Tulare Lake	December 1941
Banded in 1942			
Male			
North San Joaquin	10/16/42	5 mi. SW. of Los Banos	12/ 2/42
South San Joaquin	10/16/42	Tulare Lake	Season 1942
Female			
North San Joaquin	10/16/42	Firebaugh	10/18/42
South San Joaquin	10/16/42	Tulare Lake	Season 1942
Banded in 1943			
Male			
Sacramento	10/16/43	Maxwell Gun Club	10/24/43
Suisun	10/16/43	Solano County	12/20/44
Female			
Sacramento	10/16/43	Thornton	10/24/43

CALIFORNIA RETURNS OF MALLARDS

Region of return	Date of banding	Place of return	Date of return
Banded in 1940			
Female			
North San Joaquin	9/22/40	Livingston	Season 1940
South San Joaquin	8/31/40	Tulare Lake	10/18/40
	8/27/40	Near Hanford	November 1941
Banded in 1941			
Male			
Sacramento Valley	19/ 9/41	Zamora	12/15/43
	0/13/41	Near Sacramento	10/22/44
Delta	9/ 9/41	San Joaquin County	11/21/41
	9/13/41	Contra Costa County	11/ 9/41
North San Joaquin	8/ 9/41	Summit Lake, Fresno County	10/22/41
	9/25/41	Los Banos	11/17/41
	9/15/41	Los Banos	Season 1942
	10/13/41	Lake Yosemite, Merced County	12/16/42
	10/13/41	Near Merced	Season 1942
	9/ 9/41	Found dead near Merced	12/ 8/43
	9/22/41	11 mi. W. of Merced	11/24/44
South San Joaquin	9/ 5/41	Tulare Lake	10/21/41
	9/13/41	Kern County	10/16/41
	9/22/41	Tulare Lake	10/29/41
	9/ 9/41	Tulare Lake	10/15/44

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF MALLARDS—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Female			
Sacramento Valley	9/13/41	Thornton	10/15/52
Delta	9/25/41	Liberty Island	10/17/42
North San Joaquin	9/29/41	Los Banos	11/30/41
	9/12/41	Modesto	11/ 2/41
	9/13/41	Tranquility	10/27/41
	9/13/41	Los Banos	10/29/41
	9/13/41	Merced County	10/19/41
	9/13/41	Chowchilla	10/25/41
	9/ 5/41	Merced County	Last of season, 1946-47
South San Joaquin	9/12/41	Tulare Lake	10/19/41
	9/13/41	Near Bakersfield	11/28/41
	9/22/41	Tulare Lake	December 1941
	9/25/41	Tulare Lake	December 1941
Banded in 1942			
Male			
Sacramento	10/16/42	15 mi. N. of Sacramento	11/15/42
	10/16/42	Ryde, Sacramento County	11/21/43
North San Joaquin	10/16/42	Ripon	12/ 1/43
Female			
South San Joaquin	10/15/42	9 mi. S. of Hanford	10/15/42
	10/15/42	Near Hanford	11/17/42
Banded in 1943			
Male			
North San Joaquin	10/15/43	Near Los Banos	1/ 1/46
South San Joaquin	10/15/43	15 mi. W. of Delano	10/15/44

CALIFORNIA RETURNS OF CINNAMON TEAL

Region of return	Date of banding	Place of return	Date of return
Banded in 1940			
Male			
South San Joaquin	9/ 7/40	Near Bakersfield	11/ 3/40
	9/22/40	Corcoran	12/20/40
Female			
North San Joaquin	8/29/40	Los Banos	10/30/40
	10/ 8/40	Firebaugh	11/25/40
Banded in 1941			
Male			
South San Joaquin	9/13/41	Buttonwillow	10/19/41
Female			
South San Joaquin	9/20/41	Tulare Lake	10/19/41
	10/13/41	Tulare Lake	November 1942
Banded in 1942			
Male			
South San Joaquin	10/16/42	Tulare Lake	Season 1942

CALIFORNIA RETURNS OF BALDPATE

Region of return	Date of banding	Place of return	Date of return
Banded in 1940			
Male			
North San Joaquin	10/17/40	Gustine	11/26/41

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL

Region of return	Date of banding	Place of return	Date of return
Banded in 1939			
Male			
Sacramento Valley	9/29/39	Yolo County	11/ 9/44
Delta	9/14/39	11 mi. from Stockton	11/12/39
Suisun Marsh	9/14/39	Suisun Marshes	11/10/43
North San Joaquin Valley	9/29/39	Los Banos	10/25/39
	10/20/39	Los Banos	12/ 5/39
	10/15/39	Fresno	1/22/40
Female			
Sacramento Valley	9/27/39	Near Colusa	11/16/40
Delta	9/14/39	12 mi. W. of Lodi	11/22/39
South Bay	9/14/39	Warm Springs	11/ 5/40
North San Joaquin Valley	10/14/39	Gustine	11/20/42
	10/15/39	Gustine	11/20/42
	10/18/39	Los Banos	11/23/39
	10/15/39	Los Banos	11/17/40
South San Joaquin Valley	9/12/39	45 mi. NW. of Bakersfield	10/29/39
	9/14/39	Near Bakersfield	10/29/39
South Coast	10/15/39	Sunset Beach	12/ 9/42
North Coast	10/ 3/40	Eureka	1/ 6/46
Sacramento Valley	10/ 8/40	Dixon	12/14/40
	10/ 8/40	Maxwell	12/ 5/40
	10/ 9/40	Yuba County	12/14/40
	10/10/40	Franklin	11/23/40
	10/14/40	10 mi. W. of Biggs	12/28/40
	8/31/40	Sutter County	10/17/41
	10/ 3/40	Williams	12/14/41
	10/10/40	Yolo By-Pass	12/ 2/41
	10/10/40	Colusa	12/13/42
	10/ 3/40	10 mi. S. of Sacramento	12/31/44
	10/ 8/40	Yolo By-Pass	12/10/45
	10/ 9/40	Woodland	1/ 6/46
	10/14/40	Gridley	Season 1945
Delta	9/ 4/40	Stockton	11/18/40
	9/ 4/40	Stockton	10/16/40
	9/29/40	Stockton	11/ 3/40
	9/27/40	Sherman Island	11/11/41
	10/ 3/40	San Joaquin County	11/25/41
	10/10/40	8 mi. E. of Antioch	12/10/41
	9/30/40	Middle River	11/21/43
	10/14/40	Stockton	12/15/43
Suisun	9/26/40	Collinsville	12/12/40
	10/ 8/40	Cordelia	12/ 9/40
	10/14/40	Solano County	12/ 8/40
	9/29/40	Long Point, Suisun Bay	11/14/40
	10/14/40	Wheeler Island, Solano County	10/16/41
	8/ 7/40	Suisun	12/ 9/42
	9/27/40	Suisun Marsh	10/28/42
	10/14/40	Suisun Marsh	12/17/44
	10/17/40	Suisun Marsh	Season 1944
North Bay	10/ 8/40	Near Vallejo	12/ 1/41
South Bay	10/10/40	Near San Francisco	10/19/40
	10/ 9/40	Mt. Eden, Alameda County	12/ 5/43
	9/30/40	Alvarado	10/29/44
	10/10/40	Mt. Eden	12/ 1/44

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1940			
Male			
North San Joaquin	8/27/40	Fresno	10/27/40
	9/ 4/40	Los Banos	10/16/40
	9/ 6/40	Merced County	12/ 4/40
	9/18/40	Los Banos	11/30/40
	9/22/40	Modesto	November 1940
	9/27/40	Los Banos	12/ 1/40
	9/29/40	Los Banos	10/26/40
	9/30/40	Firebaugh	12/8 /40
	10/ 3/40	Dos Palos	10/25/40
	10/ 9/40	Los Banos	November 1940
	10/ 9/40	Summit Lake, Fresno County	11/14/40
	10/14/40	Firebaugh	12/14/40
	10/14/40	Crow's Landing	11/20/40
	10/14/40	Dos Palos	11/21/40
	10/17/40	Fresno	11/20/40
	8/27/40	Dos Palos	11/ 2/41
	9/27/40	Modesto	10/16/41
	10/ 8/40	Los Banos	11/16/41
	10/ 9/40	Los Banos	Season 1941
	10/10/40	Found dead, Crow's Landing	10/29/41
	10/17/40	Los Banos	Season 1941
	8/30/40	Newman	1/ 5/42
	10/ 9/40	Los Banos	Season 1942
	9/30/40	Atwater	12/ 5/43
	10/ 3/40	Dos Palos	12/22/43
	10/ 8/40	Los Banos	12/29/45
	10/ 9/40	Volta, Merced County	11/ 2/46
	10/10/40	Dos Palos	11/ 6/46
	10/17/40	Los Banos	11/17/46
South San Joaquin	8/27/40	Kings County	10/23/40
	8/30/40	Tulare Lake	10/25/40
	8/31/40	Caught and released, Corcoran	10/18/40
	8/31/40	Tulare Lake	10/20/40
	8/31/40	Tulare Lake	10/19/40
	9/ 6/40	Tulare Lake	10/27/40
	9/ 7/40	Kern County	11/13/40
	9/13/40	Caught and released at Corcoran	10/ 8/40
	9/13/40	Corcoran	9/17/40
	9/18/40	Pond	11/24/40
	9/18/40	Kern County	12/ 7/40
	9/29/40	Guernsey	11/24/40
	9/30/40	Tulare Lake	12/11/40
South San Joaquin—Continued	9/30/40	Visalia	12/14/40
	10/ 3/40	Near Bakersfield	11/24/40
	10/ 8/40	Kern County	12/14/40
	10/ 8/40	Tulare Lake	11/16/40
	10/ 8/40	Tulare Lake	10/28/40
	10/ 8/40	Near Bakersfield	12/14/40
	10/ 9/40	Delano	12/ 8/40
	10/ 9/40	Tulare Lake	Season 1940
	10/10/40	Taft	12/13/40
	10/10/40	Near Bakersfield	11/10/40
	10/10/40	Near Bakersfield	12/ 5/40
	10/10/40	Buena Vista Lake	11/24/40
	10/10/40	Kern County	11/24/40
	10/10/40	Near Bakersfield	11/24/40
	10/10/40	Near Bakersfield	December 1940
	10/10/40	Kern County	11/24/40
	10/14/40	Visalia	Fall, 1940
	10/17/40	Kings County	Season 1940
	9/29/40	Tulare Lake	December 1941
	9/29/40	Tulare Lake	December 1941
	10/ 9/40	Tulare Lake	December 1941
	10/17/40	Tulare Lake	December 1941
	10/10/40	Buena Vista Lake	11/ 8/42
	10/ 9/40	Wasco	1/20/46
South Coast	10/ 9/40	Near Eagle Rock, Los Angeles County	Season 1940
	10/10/40	Near Hollywood	11/24/40
	9/27/40	Orange County	11/25/42
	9/13/40	San Ysidro, San Diego County	12/10/43
	10/ 8/40	Betteravia Lake, Santa Barbara County	10/29/44
	10/10/40	Point Meegu Naval Station	1/ 5/48

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1940			
Female			
Sacramento Valley	8/29/40	Colusa	Season 1940
	8/31/40	Near Sacramento	11/ 5/40
	8/27/40	Gridley	11/26/41
	9/ 6/40	Sutter County	2/ 6/41
	10/ 8/40	4 mi. N. of Willows	12/18/41
	10/ 9/40	Dixon	12/14/40
	10/ 9/40	Sutter County	10/16/41
	10/10/41	14 mi. SW. of Live Oak	November 1941
	10/14/40	Near Live Oak	December 1941
	10/17/40	Colusa	October 1941
	10/ 3/40	Near Oroville	12/ 5/43
	8/29/40	Yolo County	12/ 3/44
	10/ 9/40	Nelson, Butte County	11/ 9/44
	10/17/40	Nelson, Butte County	11/10/44
	9/30/40	Butte County	11/15/45
	8/27/40	Colusa	1/ 1/48
Delta	8/30/40	San Joaquin	12/ 1/40
	9/29/40	Antioch	11/10/40
	10/17/40	10 mi. E. of Oakley	November 1941
	10/ 8/40	Van Sickle Island	November 1941
Suisun	9/ 4/40	Solano County	12/14/40
	9/22/40	Fairfield	12/14/40
	10/ 8/40	Solano County	11/24/40
	10/ 9/40	Fairfield	12/ 4/40
	10/ 9/40	Grizzly Island Duck Club	12/ 1/41
	10/17/40	Suisun Marsh	11/ 8/42
	8/31/40	Tule Belle Gun Club near Benicia	11/20/40
South Bay	10/ 8/40	San Francisco Bay	12/19/45
	10/ 3/40	Warm Springs, Santa Clara County	11/ 7/43
North San Joaquin Valley	9/22/40	Dos Palos	12/14/40
	9/26/40	47 mi. NW. of Fresno	11/10/40
	9/26/40	Fresno	Season 1940
	9/30/40	Gustine	12/ 1/40
	10/ 3/40	Dos Palos	12/ 5/40
	10/ 8/40	Dos Palos	11/17/40
	10/ 8/40	Riverdale	11/10/40
	10/ 8/40	Los Banos	12/ 8/40
	10/ 8/40	Los Banos	12/ 8/40
	10/ 8/40	Firebaugh	11/24/40
	10/ 9/40	Fresno	11/10/40
	10/ 9/40	Merced	12/ 8/40
	10/ 9/40	Dos Palos	12/14/40
	10/ 9/40	Near Merced	12/ 3/40
	10/ 9/40	Near Merced	11/23/40
	10/10/40	Firebaugh	12/14/40
	10/10/40	Newman	12/ 8/40
	10/14/40	Summit Lake, Fresno County	11/20/40
	10/14/40	Los Banos	11/26/40
	9/18/40	Dos Palos	10/26/41
	10/ 8/40	Gustine	December 1941
	10/ 8/40	Merced County	Season 1941
	10/10/40	Near Merced	10/21/41
	10/14/40	Atwater	Fall, 1941
	10/17/40	Mendota	11/30/41
	9/13/40	Los Banos	Season 1942
North San Joaquin	10/14/40	Gustine	December 1942
	9/22/40	Los Banos	11/ 3/43
	10/ 3/40	Los Banos	10/16/43
	10/ 8/40	Los Banos	12/19/43
	10/14/40	Gustine Gun Club	10/24/43
	9/29/40	Merced	11/ 8/44
	10/ 8/40	Los Banos	10/15/44
	10/17/40	Los Banos	11/ 1/45
South San Joaquin	8/ 7/40	Tulare Lake	11/19/40
	8/27/40	Tulare Lake	Season 1940
	9/ 4/40	Tulare Lake	10/25/40
	9/ 4/40	Near Hanford	10/27/40
	9/13/40	Corcoran	September 1940
	9/13/40	Corcoran	9/30/40

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941			
Female—Continued			
South San Joaquin—Continued	9/13/40	Corcoran	10/29/40
	9/13/40	Tulare Lake	11/25/40
	9/13/40	Tulare Lake	10/25/40
	9/13/40	Corcoran	10/ 4/40
	9/18/40	Tulare Lake	10/28/40
	9/18/40	Corcoran	10/23/40
	9/18/40	Lost Hills	11/22/40
	9/22/40	Tulare Lake	10/16/40
	9/29/40	Tulare Lake	11/24/40
	9/29/40	Delano	12/ 1/40
	10/ 3/40	Pond	11/ 3/40
	10/ 8/40	Tulare Lake	11/ 5/40
	10/ 8/40	Near Bakersfield	Season 1940
	10/ 8/40	Tulare Lake	11/11/40
	10/ 8/40	Kern County	11/24/40
	10/ 8/40	Tulare Lake	11/24/40
	10/ 8/40	17 mi. W. of Delano	Season 1940
	10/ 9/40	Pond	12/ 8/40
	10/ 9/40	Earlimart	12/13/40
	10/ 9/40	Lost Hills	12/14/40
	10/ 9/40	Near Bakersfield	11/17/40
	10/10/40	Kern County	11/24/40
	10/10/40	Delano	12/11/40
	10/10/40	Kern County	11/24/40
	10/10/40	Near Bakersfield	11/15/40
	10/10/40	Tupman	11/ 1/40
	10/10/40	Kern County	11/24/40
	10/14/40	Near Hanford	11/25/40
	10/14/40	Dinuba	11/14/40
	10/14/40	Kern County	12/ 7/40
	10/17/40	Kings County	Season 1940
	10/17/40	Dinuba	11/14/40
	10/17/40	Wasco	11/24/40
	10/17/40	Pond	11/30/40
	10/17/40	Tulare Lake	12/11/40
	10/17/40	Dinuba	11/14/40
	10/17/40	Tulare Lake	Season 1940
	9/ 6/40	Bakersfield	Season 1941
	9/ 6/40	Tulare Lake	10/19/41
	10/ 8/40	Pond	10/21/41
	10/17/40	Tulare Lake	December 1941
	10/17/40	Tulare Lake	December 1941
	10/17/40	Pond	10/22/41
	10/10/40	Delano	November 1942
	10/ 8/40	Killed by hawk, Tulare Lake	11/ 1/43
	10/ 9/40	15 mi. S. of Bakersfield	10/22/44
	10/10/40	Kern County	12/ 2/45
South Coast	8/31/40	Lake Elsinore	10/30/40
Imperial Valley	9/22/40	Westmorland	1/16/44
Male			
North Coast	9/20/41	Clear Lake	11/ 2/43
Northeastern California	10/ 1/41	Tule Lake, Siskiyou County	11/ 1/42
	10/ 9/41	Sheepy Lake, Siskiyou County	12/ 5/43
Sacramento Valley	9/ 5/41	Yuba County	11/15/41
	9/ 5/41	Sutter County	11/ 2/41
	9/ 5/41	Sacramento	10/16/41
	9/ 5/41	Butte County	11/23/41
	9/ 9/41	Near Sacramento Refuge	11/18/41
	9/12/41	15 mi. NE. of Marysville	10/22/41
	9/15/41	Yolo County	12/17/41
	10/ 3/41	Marysville	11/12/41
	10/ 1/41	Yuba City	10/16/41
	9/25/41	Willows	12/ 5/42
	10/ 9/41	5 mi. E. of Woodland	12/16/42
	10/ 9/41	Willows	12/14/42
	10/ 9/41	Yolo County	12/23/42
	10/ 3/41	Marysville	12/ 5/42
	9/ 9/41	California Gun Club, Colusa County	12/ 6/43

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Male—Continued			
Sacramento Valley—Continued	9/12/41	Butte County	Season 1943
	9/22/41	Maxwell	12/20/44
	10/ 1/41	10 mi. N. of Marysville	1/ 4/45
	9/22/41	Near Marysville	November 1944
	10/ 9/41	Marysville	12/18/44
	10/14/41	Colusa	11/12/44
	9/ 5/41	8 mi. W. of Live Oak	12/14/45
	10/ 1/41	Yolo By-Pass	January 1946
	9/25/41	Gridley	1/17/46
	9/26/41	Knight's Landing	1/12/46
	9/15/41	"O" NE. of Marysville	Fall, 1945
	10/ 4/41	Sutter By-Pass	12/16/45
	10/14/41	Williams	December 1945
	10/14/41	Williams	12/26/47
Delta	9/ 9/41	Lodi	11/ 8/41
	9/12/41	Across river from Antioch	11/ 9/41
	10/ 1/41	8 mi. W. of Lodi	11/23/41
	9/25/41	Oakley	12/14/41
	10/ 1/41	Lodi	11/19/41
	9/15/41	7 mi. W. of Lodi	11/19/41
	9/15/41	Oakley	11/ 2/41
	9/15/41	Webb Tract, Contra Costa County	11/22/41
	10/ 9/41	San Joaquin County	11/26/41
	10/ 9/41	Antioch	11/15/41
	9/22/41	Near Antioch	March 1942
	10/13/41	Sherman Island	10/18/42
	10/ 1/41	Near Tracy	December 1943
	10/13/41	Sherman Island	Season 1944
	10/ 9/41	Bishop Tract near Stockton	11/ 7/45
Suisun	10/ 1/41	Solano County	11/16/41
	10/ 4/41	Morrow Island near Benicia	10/26/41
	9/20/41	Dutton Island near Pittsburg	10/25/42
	9/ 9/41	Benicia	11/ 8/42
	9/ 5/41	Cordelia, Suisun Marshes	11/14/43
	9/ 9/41	Suisun Marsh	10/18/43
	10/ 1/41	Suisun Bay	10/28/43
	10/ 9/41	Suisun Marsh	10/23/43
	10/ 9/41	Suisun Bay	11/11/43
	10/13/41	Suisun	11/21/43
	9/22/41	Suisun Marshes	11/ 5/44
	10/ 9/41	Suisun	12/ 6/46
North Bay	10/ 9/41	San Pablo Bay	12/ 1/43
	9/15/41	Vallejo	11/ 8/44
	10/13/41	Vallejo	11/ 8/44
	10/ 1/41	5 mi. from Sonoma	12/18/45
	10/ 3/41	Vallejo	Season 1947
South Bay	10/ 1/41	Near San Francisco	11/19/41
	10/13/41	Near San Francisco	November 1941
	10/14/41	Near San Francisco	11/ 4/42
	9/13/41	Bay Farm Island, Alameda County	11/13/43
	9/20/41	Mt. Eden, Alameda County	10/15/43
	9/20/41	Alameda	11/ 7/43
	10/14/41	Irvington	1/20/46
Central Coast	10/ 4/41	Near Monterey	11/23/41
North San Joaquin	9/ 5/41	Los Banos	11/ 9/41
	9/ 9/41	Between Dos Palos and Los Banos	11/ 2/41
	9/ 9/41	Los Banos	12/ 3/41
	9/ 9/41	7 mi. E. of Los Banos	11/20/41
	9/13/41	Los Banos	11/16/41
	9/13/41	15 mi. E. of Gustine	10/26/41
	9/13/41	Los Banos	11/19/41
	9/22/41	Newman	11/ 2/41
	9/22/41	Near Ripon	10/26/41
	9/22/41	South Dos Palos	October 1941
	9/22/41	Modesto	11/ 2/41
	9/22/41	Fresno	Fall, 1941
	9/22/41	Mendota	10/23/41
	9/22/41	South Dos Palos	10/26/41
	9/22/41	Riverdale	11/23/41
	9/22/41	Riverdale	11/21/41

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Male—Continued			
North San Joaquin—Continued	10/ 1/41	South Dos Palos	December 1941
	10/ 1/41	6 mi. W. of Modesto	10/29/41
	10/ 1/41	7 mi. W. of Fresno	11/ 9/41
	10/ 1/41	Fresno	11/ 1/41
	10/ 1/41	Near Fresno	Fall, 1941
	10/ 1/41	Madera	11/ 9/41
	10/ 1/41	Los Banos	11/28/41
	10/ 1/41	SW. of Modesto	11/18/41
	10/ 1/41	Turlock	12/ 2/41
	10/ 1/41	Los Banos	Season 1941
	10/ 1/41	South Dos Palos	11/ 7/41
	10/ 1/41	Los Banos	12/ 7/41
	10/ 1/41	South Dos Palos	10/30/41
	10/ 1/41	Madera County	11/ 5/41
	9/25/41	Dos Palos	10/16/41
	9/25/41	Los Banos	Season 1941
	9/25/41	Atwater	11/18/41
	9/25/41	20 mi. W. of Fresno	11/ 9/41
	10/ 1/41	Merced County	11/12/41
	10/ 1/41	Los Banos	11/ 2/41
	10/ 1/41	2 mi. W. of Merced	12/ 1/41
	10/ 1/41	5 mi. NW. of Dos Palos	11/30/41
	9/15/41	Gustine	10/19/41
	9/15/41	Dos Palos	11/20/41
	9/15/41	Los Banos	11/23/41
	9/15/41	Los Banos	11/ 3/41
	9/20/41	Dos Palos	11/13/41
	9/20/41	Helm	10/21/41
	9/20/41	3 mi. S. of Dos Palos	11/23/41
	9/20/41	Kerman	11/10/41
	9/20/41	Los Banos	10/20/41
	9/20/41	7 mi. W. of Fresno	11/11/41
	9/20/41	Modesto	10/29/41
	9/22/41	Merced	11/10/41
	9/22/41	Los Banos	10/26/41
	9/22/41	Los Banos	11/ 2/41
	10/ 9/41	Los Banos	11/23/41
	10/ 9/41	Near Fresno	Fall, 1941
	10/ 9/41	Los Banos	11/ 9/41
	10/ 9/41	Mendota	11/ 9/41
	10/ 9/41	Madera	11/ 9/41
	10/ 9/41	Riverdale	11/16/41
	10/ 9/41	Livingston	11/21/41
	10/ 9/41	Newman	11/ 9/41
	10/ 9/41	Near Madera	11/ 9/41
	10/ 9/41	3 mi. W. of Los Banos	11/26/41
	10/ 9/41	Near Chowchilla	10/30/41
	10/ 9/41	South Dos Palos	11/30/41
	10/ 9/41	7 mi. N. of Los Banos	10/ 9/41
	10/ 9/41	Los Banos	11/ 9/41
	10/13/41	Madera County	11/ 2/41
	10/13/41	Firebaugh	11/11/41
	10/13/41	Madera County	11/ 7/41
	10/13/41	Merced County	Fall, 1941
	10/13/41	Near Fresno	11/26/41
	10/13/41	Mendota	Season 1941
	10/13/41	Los Banos	11/ 2/41
	10/13/41	Fresno	11/ 9/41
	10/ 4/41	Merced County	11/ 6/41
	10/ 4/41	Gustine	11/ 9/41
	10/ 9/41	7 mi. W. of Fresno	12/23/41
	10/ 9/41	Near Fresno	Fall, 1941
	10/ 9/41	Gustine	11/29/41
	10/ 9/41	Near Fresno	11/29/41
	10/ 9/41	Near Madera	11/ 9/41
	10/ 9/41	Los Banos	11/ 9/41
	10/ 9/41	Gustine	11/30/41
	10/ 9/41	2 mi. NW. of Dos Palos	11/23/41
	10/13/41	5 mi. SE. of Gustine	November 1941
	10/13/41	Los Banos	11/ 9/41

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Male—Continued			
North San Joaquin—Continued	10/ 9/41	Livingston	11/21/41
	10/ 9/41	Newman	11/ 9/41
	10/ 9/41	Near Madera	11/ 9/41
	10/ 9/41	3 mi. W. of Los Banos	11/26/41
	10/ 9/41	Near Chowchilla	10/30/41
	10/ 9/41	South Dos Palos	11/30/41
	10/ 9/41	7 mi. N. of Los Banos	10/ 9/41
	10/ 9/41	Los Banos	11/ 9/41
	10/13/41	Madera County	11/ 2/41
	10/13/41	Firebaugh	11/11/41
	10/13/41	Madera County	11/ 7/41
	10/13/41	Merced County	Fall, 1941
	10/13/41	Near Fresno	11/26/41
	10/13/41	Mendota	Season 1941
	10/13/41	Los Banos	11/ 2/41
	10/13/41	Fresno	11/ 9/41
	10/ 4/41	Merced County	11/ 6/41
	10/ 4/41	Gustine	11/ 9/41
	10/ 9/41	7 mi. W. of Fresno	12/23/41
	10/ 9/41	Near Fresno	Fall, 1941
	10/ 9/41	Gustine	11/29/41
	10/ 9/41	Near Fresno	11/29/41
	10/ 9/41	Near Madera	11/ 9/41
	10/ 9/41	Los Banos	11/ 9/41
	10/ 9/41	Gustine	11/30/41
	10/ 9/41	3 mi. NW. of Dos Palos	11/23/41
	10/13/41	5 mi. SE. of Gustine	November 1941
	10/13/41	Los Banos	11/ 9/41
	10/13/41	Near Los Banos	11/19/41
	10/13/41	Los Banos	11/22/41
	10/14/41	South Dos Palos	11/11/41
	10/ 3/41	Firebaugh	11/ 5/41
	9/ 5/41	Fresno County	12/23/42
	9/15/41	15 mi. SW. of Fresno	11/ 8/42
	9/15/41	1 mi. SW. of Dos Palos	12/20/42
	10/13/41	Gustine	12/20/42
	10/14/41	Los Banos	12/16/42
	9/ 5/41	Near Fresno	10/15/43
	9/29/41	Los Banos	11/11/43
	10/ 9/41	9 mi. S. of Los Banos	11/21/43
	10/13/41	6 mi. E. of Gustine	11/23/43
	10/13/41	Madera County	11/ 9/43
	10/ 3/41	South Dos Palos	12/ 5/43
	10/18/41	Madera	Season 1944
	10/18/41	Los Banos	11/27/44
	10/14/41	Gustine	10/22/44
	10/13/41	5 mi. SW. of South Dos Palos	December 1946
	10/14/41	Los Banos	11/17/46
South San Joaquin Valley	9/ 5/41	Found dead near Corcoran	10/26/41
	9/ 5/41	Delano	10/20/41
	9/ 9/41	Pond	Fall, 1941
	9/ 9/41	Near Hanford	November 1941
	9/ 9/41	Lost Hills	10/16/41
	9/12/41	Lost Hills	10/16/41
	9/12/41	Tulare Lake	December 1941
	9/13/41	Lost Hills	November 1941
	9/22/41	Tulare Lake	December 1941
	9/22/41	Corcoran	10/26/41
	9/22/41	Tulare Lake	December 1941
	9/22/41	Tulare Lake	10/19/41
	9/22/41	Corcoran	10/26/41
	10/ 1/41	Tulare Lake	December 1941
	10/ 1/41	Near Bakersfield	11/20/41
	10/ 1/41	Tulare Lake	December 1941
	10/ 1/41	Near Visalia	11/16/41
	10/ 1/41	Tulare Lake	December 1941
	9/25/41	Pond	10/18/41
	9/25/41	Tulare Lake	10/21/41
	9/25/41	Wasco	11/23/41
	9/25/41	Tulare Lake	10/19/41
	9/29/41	Near Bakersfield	10/16/41
	9/29/41	Kern County	11/16/41
	9/29/41	Buena Vista Lake	10/19/41

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Male—Continued			
South San Joaquin Valley —Continued	9/29/41	Near Bakersfield	Season 1941
	9/29/41	Near Bakersfield	10/16/41
	9/29/41	Tulare Lake	10/16/41
	9/29/41	Buena Vista Lake	10/26/41
	9/29/41	6 mi. NW. of Buena Vista Lake	12/ 7/41
	10/ 1/41	Pond	December 1941
	10/ 1/41	Tulare Lake	December 1941
	9/15/41	40 mi. N. of Bakersfield	11/ 2/41
	9/15/41	Tulare Lake	11/16/41
	9/15/41	Wasco	11/ 3/41
	9/15/41	Near Bakersfield	11/20/41
	9/15/41	Near Hanford	10/21/41
	9/15/41	Tulare Lake	10/24/41
	9/15/41	Lost Hills	10/16/41
	9/15/41	Tulare Lake	December 1941
	9/15/41	Tulare Lake	December 1941
	9/20/41	Laton	10/19/41
	9/20/41	Tulare Lake	10/21/41
	9/20/41	Tulare Lake	10/26/41
	9/20/41	Tulare Lake	December 1941
	9/20/41	Tulare Lake	10/19/41
	9/20/41	Laton	10/19/41
	10/ 9/41	Visalia	November 1941
	10/ 9/41	Kern County	October 1941
	10/ 9/41	Near Hanford	December 1941
	10/ 9/41	Tulare Lake	Season 1941
	10/ 9/41	Near Corcoran	10/25/41
	10/13/41	Near Hanford	December 1941
	10/13/41	Tulare Lake	December 1941
	10/13/41	Tulare Lake	December 1941
	10/13/41	Tulare Lake	11/ 9/41
	10/13/41	Kern County	11/24/41
	10/22/41	Tulare Lake	11/26/41
	10/ 4/41	Pond	11/ 8/41
	10/ 4/41	Tulare Lake	11/ 4/41
	10/ 4/41	Tulare Lake	10/26/41
	10/ 9/41	Near Hanford	December 1941
	10/13/41	Kern County	October 1941
	10/13/41	Tulare Lake	10/21/41
	10/13/41	Tulare Lake	11/16/41
	10/13/41	Near Hanford	11/24/41
	10/14/41	Tulare Lake	December 1941
	10/14/41	9 mi. S. of Corcoran	1941
	10/14/41	Tulare Lake	December 1941
	10/14/41	Tulare Lake	11/28/41
	10/14/41	Tulare Lake	December 1941
	10/14/41	Tulare Lake	12/ 1/41
	10/ 3/41	Tulare Lake	December 1941
	10/ 1/41	Kern County	11/15/42
	9/25/41	Kern County	10/31/42
	10/13/41	Near Bakersfield	10/19/42
	10/13/41	Near Hanford	September 1942
	10/ 1/41	Tulare Lake	11/ 6/43
	10/ 1/41	Tulare Lake	12/15/43
	10/13/41	Tulare Lake	10/15/43
	10/ 9/41	Tulare Lake	10/23/43
	9/20/41	Band found in yard in Coalinga	7/22/44
	10/13/41	Hanford	11/26/44
	10/13/41	Pond	11/19/44
	10/14/41	Lost Hills	12/10/44
	10/14/41	Tulare Lake	11/15/44
	9/25/41	Near Bakersfield	11/10/46
	10/ 1/41	16 mi. NW. of Wasco	10/30/46
	10/22/41	Athletic Gun Club, 15 mi. NW. of Bakersfield	11/24/46
	9/20/41	L.A.A.C. Gun Club, near Bakersfield	10/22/47
South Coast	10/ 1/41	Oxnard	11/ 2/41
	10/13/41	Carlsbad	12/14/42
	10/ 1/41	Lake Elsinore	11/17/43
	10/ 1/41	35 mi. N. of San Diego	10/15/43
	9/13/41	Oceanside	12/25/44
	9/15/41	Irvine Lake, Orange County	10/14/44

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURN OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Male—Continued			
Imperial Valley	9/20/41	Salton Sea	11/ 8/42
	9/15/41	Salton Sea	10/31/43
Female			
Northeastern California	10/14/41	Westwood Lake, Lassen County	12/ 4/42
	10/ 3/41	Tule Lake, Siskiyou County	10/27/42
	9/25/41	Honey Lake, Lassen County	10/24/43
Sacramento Valley	9/ 9/41	Near Franklin	10/18/41
	10/ 1/41	40 mi. N. of Sacramento	11/20/41
	9/29/41	Sacramento Valley	November 1941
	10/ 1/41	5 mi. W. of Gridley	12/ 1/41
	10/ 4/41	Marysville	12/ 1/41
	10/ 4/41	Sutter County	11/23/41
	10/ 4/41	Thornton	12/ 7/41
	10/ 9/41	Yolo By-Pass	11/23/41
	10/ 3/41	Colusa County	11/11/41
	10/ 3/41	12 mi. SE. of Dixon	11/30/41
	10/ 1/41	Aero Gun Club, Sutter By-Pass	11/29/42
	10/13/41	Near Marysville	11/ 1/42
	10/13/41	Colusa County	12/12/42
	10/ 9/41	5 mi. S. of Grimes	12/23/42
	10/ 3/41	Near Willows	12/18/42
	10/13/41	North Butte Gun Club, Butte County	11/ 3/43
	10/ 7/41	Colusa	12/18/44
	10/ 4/41	Sutter County	10/14/44
	10/14/41	Near Spaulding Refuge	1/ 1/45
	9/15/41	Gridley	1/20/46
	10/ 9/41	Colusa	12/ 4/46
Delta	9/13/41	Near Lodi	10/23/41
	9/22/41	9 mi. W. of Lodi	11/ 9/41
	10/ 1/41	Rio Vista	11/16/41
	10/ 1/41	Stockton	11/11/41
	9/20/41	Lodi	11/11/41
	10/ 9/41	Stockton	11/23/41
	10/ 9/41	Stockton	11/19/41
Suisun Marshes	9/25/41	Benica	11/30/41
	9/20/41	Suisun Marsh	12/10/41
	10/ 3/41	Suisun Bay	11/19/41
	10/13/41	Suisun Bay	10/15/42
	9/ 5/41	Suisun Marsh	11/ 3/43
	9/ 9/41	Chipps Island	11/ 7/43
	9/ 9/41	Suisun Bay	12/ 7/43
	10/ 1/41	Grizzly Island	12/22/43
	10/18/41	Simmons Island, Solano County	11/ 3/47
North Bay	9/22/41	Petaluma Marsh	11/18/46
South Bay	10/ 9/41	Near San Francisco	11/ 9/41
	10/ 4/41	Newark	Fall, 1941
North San Joaquin	9/ 9/41	Modesto	November 1941
	9/ 9/41	19 mi. W. of Fresno	10/19/41
	9/ 9/41	Los Banos	10/19/41
	9/ 9/41	5 mi. W. of Ripon	11/ 2/41
	9/ 9/41	20 mi. W. of Fresno	10/21/41
	9/12/41	Gustine	11/ 3/41
	9/13/41	Dos Palos	10/16/41
	9/22/41	Dos Palos	December 1941
	9/22/41	Gustine	10/19/41
	9/22/41	Los Banos	10/26/41
	9/22/41	Near Fresno	11/ 5/41
	9/22/41	Gustine	10/29/41
	10/ 1/41	8 mi. SW. of Fresno	11/ 5/41
	10/ 1/41	Tranquility	10/26/41
	10/ 1/41	12 mi. W. of Modesto	11/ 9/41
	9/25/41	Kerman	10/29/41
	9/25/41	Firebaugh	10/29/41
	9/25/41	Madera County	11/30/41
	9/25/41	20 mi. NW. of Fresno	11/23/41
	9/29/41	Los Banos	10/28/41
	9/29/41	Tranquility	10/26/41
	10/ 1/41	Modesto	11/ 5/41

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Female—Continued			
North San Joaquin—Continued	10/ 1/41	Gustine	11/20/41
	10/ 1/41	Los Banos	12/ 3/41
	10/ 1/41	Fresno	11/25/41
	10/ 1/41	Los Banos	11/20/41
	9/13/41	South Dos Palos	11/ 9/41
	9/15/41	Near Fresno	Fall, 1941
	9/15/41	Fresno	Fall, 1941
	9/15/41	South Dos Palos	December 1941
	9/20/41	Los Banos	Fall, 1941
	9/22/41	Dos Palos	10/26/41
	9/22/41	Los Banos	10/ 2/41
	9/22/41	Turlock	11/ 2/41
	10/ 9/41	Firebaugh	11/ 9/41
	10/ 9/41	Los Banos	11/23/41
	10/ 9/41	Los Banos	11/17/41
	10/ 9/41	Dos Palos	Fall, 1941
	10/ 9/41	Near Fresno	11/11/41
	10/ 9/41	8 mi. W. of Fresno	11/23/41
	10/ 9/41	7 mi. W. of Fresno	12/23/41
	10/ 9/41	Los Banos	11/23/41
	10/13/41	Dos Palos	11/ 9/41
	10/13/41	Mendota	11/19/41
	10/18/41	Dos Palos	11/23/41
	10/25/41	Mendota	November 1941
	10/ 4/41	Near Fresno	11/26/41
	10/ 4/41	Los Banos	11/ 5/41
	10/ 4/41	Los Banos	12/ 7/41
	10/ 4/41	6 mi. SE. of Dos Palos	12/ 2/41
	10/ 4/41	Near Fresno	10/29/41
	10/ 4/41	Mendota	11/23/41
	10/ 4/41	Los Banos	11/16/41
	10/ 9/41	Riverdale	10/16/41
	10/13/41	Dos Palos	11/25/41
	10/13/41	Gustine	11/16/41
	10/13/41	5 mi. NW. of Dos Palos	11/26/41
	10/14/41	Near Merced	12/ 7/41
	10/14/41	Near Merced	11/17/41
	10/14/41	Los Banos	12/ 3/41
	10/ 3/41	Mendota	11/ 2/41
	10/ 3/41	3½ mi. SW. of Atwater	November 1941
	10/ 3/41	Modesto	11/ 5/41
	10/ 1/41	Newman	10/25/42
	10/ 1/41	Dos Palos	12/16/42
	10/ 1/41	Los Banos	11/ 1/42
	9/25/41	Los Banos	Season 1942
	9/29/41	South Dos Palos	10/25/42
	10/ 9/41	Los Banos	Season 1942
	10/ 4/41	Near Dos Palos	11/17/42
	10/ 4/41	Los Banos	11/25/42
	10/13/41	Gustine	11/15/42
	10/14/41	Los Banos	11/25/42
	10/14/41	Gustine	11/ 1/42
	10/14/41	Dos Palos	12/12/42
	9/22/41	Los Banos	10/24/43
	9/29/41	Gustine Gun Club	Season 1943
	10/ 9/41	Gustine	10/31/43
	10/13/41	Gustine	11/24/43
	10/ 9/41	Gustine	11/28/43
	10/ 3/41	Turner Island near Los Banos	12/ 5/43
	10/ 3/41	Los Banos	12/19/43
	10/ 1/41	Dos Palos	11/ 1/44
	10/ 1/41	Los Banos	11/ 1/44
	9/20/41	Gustine	11/29/44
	9/22/41	Dos Palos	1/16/46
	10/ 3/41	Los Banos	11/25/45
	10/ 1/41	7 mi. W. of Merced	11/ 3/46
	10/ 1/41	Los Banos	10/21/47
South San Joaquin	9/ 5/41	West side of Tulare Lake	10/17/41
	9/ 9/41	Near Hanford	10/16/41
	9/ 9/41	5 mi. NW. of Visalia	11/19/41
	9/12/41	Tulare Lake	10/19/41
	9/12/41	Tulare Lake	December 1941
	9/15/41	Turnbull	Fall, 1941
	9/22/41	Near Hanford	10/22/41

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1941—Continued			
Female—Continued			
South San Joaquin—Continued	9/22/41	Corcoran	10/26/41
	9/22/41	Tulare Lake	10/19/14
	9/22/41	Tulare Lake	10/28/41
	9/22/41	Delano	10/19/41
	9/25/41	Tulare Lake	December 1941
	9/25/41	Alpaugh	10/26/41
	9/29/41	Buena Vista Lake	10/19/41
	9/29/41	Near Bakersfield	Season 1941
	10/ 1/41	Tulare Lake	10/24/41
	10/ 1/41	Tulare Lake	10/26/41
	10/ 1/41	Tulare Lake	December 1941
	10/ 1/41	Alpaugh	11/ 1/41
	9/20/41	Tulare Lake	10/27/41
	9/20/41	Corcoran	11/16/41
	9/20/41	Corcoran	10/26/41
	9/20/41	Dinuba	11/ 9/41
	9/22/41	Tulare Lake	December 1941
	9/22/41	Tulare Lake	December 1941
	10/ 9/41	Tulare Lake	December 1941
	10/ 9/41	Tulare Lake	December 1941
	10/ 9/41	Tulare Lake	December 1941
	10/ 9/41	Tulare Lake	December 1941
	10/ 9/41	Tulare Lake	December 1941
	10/ 9/41	Tulare Lake	11/13/41
	10/ 9/41	Near Hanford	December 1941
	10/ 9/41	Tulare Lake	Season 1941
	10/13/41	Tulare Lake	December 1941
	10/13/41	Tulare Lake	11/22/41
	10/13/41	Tulare Lake	December 1941
	10/18/41	Tulare Lake	12/ 1/41
	10/18/41	Tulare Lake	December 1941
	10/ 4/41	Near Hanford	11/ 9/41
	10/ 4/41	Kings County	11/ 2/41
	10/ 4/41	Tulare Lake	12/ 1/41
	10/ 4/41	Near Hanford	11/ 9/41
	10/ 4/41	Near Hanford	December 1941
	10/ 9/41	Tulare Lake	No date, 1941
	10/ 9/41	Corcoran	10/20/41
	10/ 9/41	Tulare Lake	11/16/41
	10/13/41	Tulare Lake	December 1941
	10/13/41	Tulare Lake	December 1941
	10/13/41	4 mi. S. of Wasco	11/25/41
	10/13/41	Tulare Lake	11/21/41
	10/14/41	10 mi. S. of Tulare Lake	11/15/41
	10/14/41	Tulare Lake	December 1941
	10/14/41	Tulare Lake	December 1941
	10/14/41	Tulare Lake	12/ 7/41
	10/ 3/41	Corcoran	10/26/41
	10/ 3/41	15 mi. SW. of Corcoran	December 1941
	10/ 3/41	Tulare Lake	10/18/41
	10/ 4/41	Band found in school yard, Lemoore	March 1942
	10/ 9/41	Buena Vista Lake	11/29/42
	10/13/41	Pond	11/30/43
	10/ 9/41	Lost Hills	11/ 2/45
South Coast	9/13/41	Long Beach	11/ 2/42
	9/22/41	Oceanside	12/20/42
	10/ 1/41	Farmer's Gun Club, Cypress	12/ 2/42
	10/ 4/41	Lake Henshaw	12/ 5/43
	10/ 3/41	Big Bear Lake	10/13/48
Banded in 1942			
Male			
Sacramento Valley	10/16/42	10 mi. S. of Sacramento	12/13/42
	10/16/42	Yolo County	Season 1942
	10/16/42	Courtland	12/15/44
Delta	10/16/42	Oakley	11/ 7/43
Suisun	10/16/42	Solano County	Season 1943
	10/16/42	Suisun Bay	11/ 7/43.
North San Joaquin	10/16/42	Gustine	11/22/42
	10/16/42	Gustine	12/ 6/42
	10/16/42	Firebaugh	12/10/44
	10/16/42	Gustine	12/ 2/45

TABLE 21—Continued

Return Data on Individual Ducks Within California

CALIFORNIA RETURNS OF PINTAIL—Continued

Region of return	Date of banding	Place of return	Date of return
Banded in 1942—Continued			
Male—Continued			
South San Joaquin	10/16/42	9 mi. S. of Hanford	Fall, 1942
	10/16/42	Tulare Lake	10/18/42
	10/16/42	Tulare Lake	Season 1942
	10/16/42	Tulare Lake	Season 1942
	10/16/42	Kings County	10/26/46
Mojave Desert	10/16/42	Near Lancaster	10/28/42
South Coast	10/16/42	Point Mugu, Ventura County	12/ 6/42
Female			
Delta	10/16/42	20 mi. from Stockton	Season 1942
Suisun	10/16/42	Suisun	10/28/42
South Bay	10/16/42	Near Hayward	12/12/43
North San Joaquin	10/16/42	Near Fresno	11/29/42
	10/16/42	Near Los Banos	10/19/42
	10/16/42	Modesto	11/25/42
	10/16/42	Burrel	10/18/42
	10/16/42	Santa Cruz Gun Club, Los Banos	December 1943
	10/16/42	Los Banos	11/ 1/44
South San Joaquin	10/16/42	Tulare Lake	Season 1942
	10/16/42	Tulare Lake	Season 1942
	10/16/42	9 mi. S. of Hanford	Fall 1942
	10/16/42	Tulare Lake	Season 1942
	10/16/42	Near Bakersfield	11/ 1/43
	10/16/42	Wasco	11/ 5/44
Banded in 1943			
Male			
Sacramento Valley	10/16/43	Sacramento	11/15/44
	10/16/43	Elk Grove	December 1946
Delta	10/16/43	Ringer Tract, San Joaquin County	12/12/43
	10/16/43	Lodi	11/24/43
	10/16/43	Near Tracy	December 1943
	10/16/43	Northern San Joaquin County	11/17/43
	10/16/43	Orwood Tract, Brentwood	10/27/43
	10/16/43	Lodi	12/15/44
	10/16/43	Stockton	11/ 2/45
Suisun	10/16/43	Suisun	10/27/43
North San Joaquin	10/16/43	Firebaugh	11/ 3/43
	10/16/43	9 mi. E. of Waterford	11/ 7/43
	10/16/43	Near Fresno	12/ 6/43
	10/16/43	9 mi. E. of Los Banos	11/21/43
	10/16/43	Los Banos	12/ 5/43
	10/16/43	Dos Palos	11/10/43
	10/16/43	Los Banos	10/20/43
	10/16/43	Mendota, found dead	4/ 1/46
South San Joaquin	10/16/43	Tulare Lake	10/26/43
	10/16/43	Tulare Lake	11/27/43
	10/16/43	Beverly Gun Club, Kern County	11/15/43
	10/16/43	Tulare Lake	12/22/43
	10/16/43	Tulare Lake	11/11/43
	10/16/43	Tulare Lake	10/27/43
	10/16/43	Tulare Lake	10/19/43
	10/16/43	Tulare Lake	10/19/43
Imperial Valley	10/16/43	5 mi. NW. of Calipatria	2/ 2/44
Female			
Delta	10/16/43	7 mi. W. of Lodi	11/ 7/43
	10/16/43	20 mi. NW. of Stockton	12/ 1/43
North San Joaquin	10/16/43	Near Fresno	11/ 3/43
South San Joaquin	10/16/43	Pond	11/ 8/43

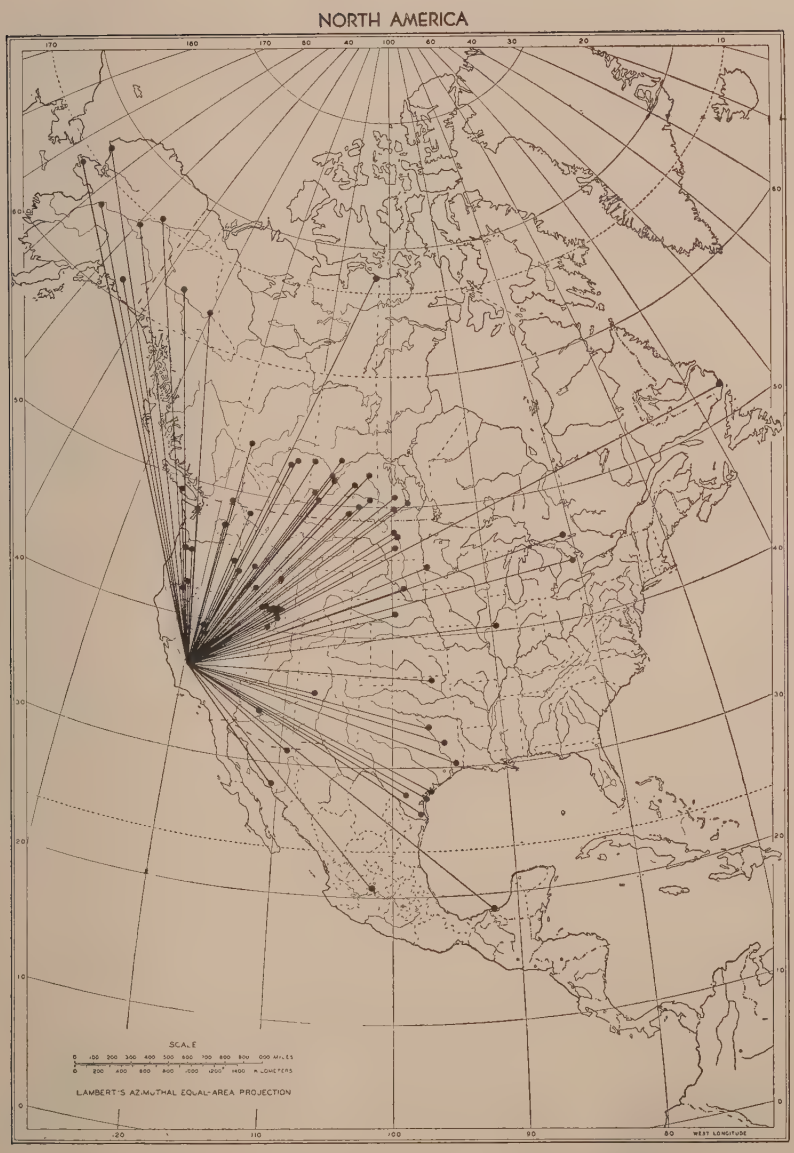

FIGURE 29. Total returns of ducks from outside California

TABLE 22

Return Data on Individual Ducks Outside California

Sex	Species	Date banded	Location of return	Date of return
			1939	
♀	Pintail	10/20/39	Rockport, Texas	12/29/44
♂	Green-winged teal	9/12/39	Alcomdale, Alberta	10/27/41
♂	Green-winged teal	10/15/39	San Antonio, Texas	12/14/40
♀	Green-winged teal	10/20/39	Shelter Bay, British Columbia	9/20/42
♀	Green-winged teal	10/20/39	Back Bay, San Juan Is., Washington	10/18/42
			1940	
♂	Pintail	8/ 7/40	Stove Creek, Saskatchewan	5/ 6/41
♂	Pintail	8/31/40	Hartford, South Dakota	3/29/44
♂	Pintail	9/ 6/40	Heisler, Alberta	10/17/43
♂	Pintail	9/ 7/40	Arelee, Saskatchewan	Feb. 1942
♀	Pintail	9/29/40	Perry River, Queen Maud Gulf, Arctic Canada	Aug. 1941
♂	Pintail	9/29/40	Springfield, Oregon	11/19/44
♀	Pintail	10/ 3/40	Stillwater, Nevada	10/30/41
♂	Pintail	10/ 8/40	Pump "L," Creighton Mine, Ontario	11/ 7/46
♂	Pintail	10/ 9/40	Lower Klamath Lake, Oregon	11/ 1/43
♀	Pintail	10/ 9/40	5 mi. E. of Reno, Nevada	11/17/46
♀	Pintail	10/ 9/40	Lloydminster, Saskatchewan	4/19/44
♀	Pintail	10/10/40	Mayo, Yukon Territory, Canada	May, 1942
♀	Pintail	10/10/40	Havana, Illinois	12/ 2/40
♀	Pintail	10/14/40	Brigham, Utah	Season 1942
♀	Pintail	10/17/40	Delburne, Alberta	10/ 2/41
♂	Pintail	10/17/40	Fort Severn, Ontario	June 1946
♂	Pintail	10/17/40	Massett, Queen Charlotte Is., B. C.	1/12/42
♀	Pintail	10/17/40	Minnewaukan, North Dakota	10/26/41
♂	Green-winged teal	9/22/40	Picabo, Idaho	12/22/42
♂	Green-winged teal	9/26/40	Henley Harbor, Straits of Belle Isle, Labrador	6/10/43
♂	Green-winged teal	10/ 8/40	Ontario, Oregon	11/19/41
			1941	
♀	Pintail	9/ 5/41	Aguascalientes, Aguascalientes, Mexico	12/27/42
♂	Pintail	9/ 5/41	Teloo Lake, Yukon Territory, Canada	June 1943
♂	Pintail	9/ 9 41	Hockley, Texas	11/ 7/44
♂	Pintail	9/15/41	Whitewood Lake, 11 mi. N. of Raymore, Saskatchewan	8/16/43
♂	Pintail	9/15/41	Royal Municipality, Saskatchewan	5/19/44
♂	Pintail	9/15/41	Bear River, Utah	8/27/42
♂	Pintail	9/20/41	Grandview, Idaho	12/20/41
♂	Pintail	9/20/41	Layland, Manitoba	Fall, 1942
♀	Pintail	9/20/41	5 mi. S. of San Luis, Arizona, in Mexico	11/ 5/42
♂	Pintail	9/20/41	Hamshire, Texas	11/21/42
♀	Pintail	9/22/41	Climax, Saskatchewan	Sept. 1942
♂	Pintail	9/22/41	Caro, Alaska	5/13/42
♂	Pintail	9/25/41	Inola, Oklahoma	12/13/41
♂	Pintail	9/25/41	3 mi. N. of Wales, Alaska	9/ 9/42
♂	Pintail	9/25/41	Wasaga Beach, Ontario	8/16/43
♂	Pintail	9/25/41	Erickson, Nebraska	11/15/42
♀	Pintail	10/ 1/41	Walker Lake, Nevada	10/25/44
♀	Pintail	10/ 1/41	Lisieux, Saskatchewan	11/ 1/44
♀	Pintail	10/ 1/41	Twin Falls, Idaho	12/21/44
♂	Pintail	10/ 1/41	St. Michaels, Arizona	12/ 6/42
♀	Pintail	10/ 1/41	Leeds, North Dakota	10/23/43
♂	Pintail	10/ 3/41	Minto, Alaska	6/13/44
♀	Pintail	10/ 3/41	Kivalina, Alaska	5/24/44
♀	Pintail	10/ 3/41	20 mi. N. of Valley City, North Dakota	10/ 1/43
♀	Pintail	10/ 4/41	Near Riceton, Saskatchewan	Fall, 1942
♂	Pintail	10/ 4/41	Swift Current, Saskatchewan	9/30/46
♀	Pintail	10/ 4/41	20 mi. NW. of Eugene, Oregon	12/ 5/46
♀	Pintail	10/ 4/41	Blackfoot, Idaho	Last of Dec. 1945
♂	Pintail	10/ 4/41	Near Odessa, Lincoln Co., Washington	Nov. 1942
♂	Pintail	10/ 9/41	3 mi. S. Stockholm, Saskatchewan	10/ 2/43
♂	Pintail	10/ 9/41	Salt Lake City, Utah	Season 1943
♀	Pintail	10/ 9/41	Yaqui Valley, Sonora, Mexico	2/ 8/46
♀	Pintail	10/ 9/41	Galena, Alaska	Season 1942
♀	Pintail	10/ 9/41	3 mi. W. of Garfield, Utah	10/24/42
♂	Pintail	10/ 9/41	Ennis, Texas	Season 1944
♀	Pintail	10/ 9/41	Carson Sink, Nevada	11/ 1/47
♂	Pintail	10/ 9/41	Delisle, Saskatchewan	4/ ?/44
♂	Pintail	10/13/41	Bear River Refuge, Utah	11/27/46
♂	Pintail	10/13/41	15 mi. N. of Brandon, Manitoba	10/10/42
♂	Pintail	10/13/41	Onanole, Manitoba	11/ 2/43
♀	Pintail	10/13/41	Mouth of Bear River, Utah	11/17/42
♀	Pintail	10/13/41	35 mi. S. of Carmen, Campeche, Mexico	5/20/43
♀	Pintail	10/13/41	Near Aransas Pass, Texas	1/10/42
♂	Pintail	10/13/41	Klamath Co., Oregon	11/26/43
♂	Pintail	10/13/41	14 mi. E. of Salt Lake City, Utah	12/ 2/45
♂	Pintail	10/13/41	10 mi. SE. of Marietta, Minnesota	11/ 2/42
♀	Pintail	10/14/41	Recovered from botulism and released, Bear River, Utah	9/ 6/42
♂	Green-winged teal	9/ 9/41	Sandpoint, Idaho	10/15/42

TABLE 22—Continued

Return Data on Individual Ducks Outside California

Sex	Species	Date banded	Location of return	Date of return
			1942	
♂	Pintail	10/16/42	Yakima River, Granger, Washington	11/20/46
♂	Green-winged teal	10/16/42	Carl Pleasant Lake, Phoenix, Arizona	12/17/44
			1943	
♀	Pintail	10/16/43	Lyford, Willacy Co., Texas	12/19/43
♀	Pintail	10/16/43	Bear River Refuge, Utah	10/26/46
♂	Pintail	10/16/43	Oliver, British Columbia	11/20/44
♂	Pintail	10/16/43	Tazlina Lake, Oklahoma	9/ 3/46
♀	Pintail	10/16/43	Little Red River, Alberta	8/25/47

THE LIFE HISTORY OF THE GREASER BLACKFISH *(ORTHODON MICROLEPIDOTUS)* OF CLEAR LAKE, LAKE COUNTY, CALIFORNIA[1]

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Clear Lake lies in central California at an elevation of 1300 feet. Its surface area is approximately 40,000 acres. The lake contains a typical California warm-water assemblage of fishes. Among them is the greaser blackfish, a member of the Cyprinidae, the carp or minnow family (Figure 30). In the San Joaquin Valley this fish is sometimes called "greaser." In past literature it has also been termed "hardhead," but this name has now been adopted for *Mylopharodon conocephalus*.

Figure 30. Greaser blackfish, *Orthodon microlepidotus* (Ayres)

The genus *Orthodon* is represented by a single species, natively restricted to the Sacramento-San Joaquin drainage basin and the Pajaro River system. It has been introduced into Carmel Reservoir on the Carmel River in Monterey County. Considerable material on its distribution and systematics can be found in publications by Rutter (1908), Snyder (1913), and Evermann and Clark (1931).

Most of the data presented in this paper were collected in the course of a general study of Clear Lake. Messrs. Richard D. Beland and Robert S. Hoffmann participated in this investigation. Some of the data were gathered at Clear Lake by Mr. J. H. Wales in 1943.

[1] Submitted for publication January, 1950.

Young and yearling fish were captured by seining with one-quarter-inch square mesh nets in the shoal areas of the lake. A few adults were captured by shoal seining with fine-meshed nets. Most adults were taken from the catch of commercial fishermen who use 1½-inch square mesh hung on seines up to 1800 feet in length.

Throughout this paper all lengths refer to fork length taken from the tip of the snout to the fork of the caudal fin.

GENERAL ECOLOGY OF THE GREASER BLACKFISH

Throughout its native range, the blackfish inhabits lowland areas typified by shallow lakes and sluggish sloughs. It avoids even moderately swift running water. Unlike most carps native to the Sacramento-San Joaquin, the blackfish is a "lake" spawner.

The blackfish is of interest to fish management because of its importance as a commercial species and because of its relation to warm-water game fishes. In most respects the blackfish has the characteristics of a good forage species. It is prolific, it does not compete with game fish for food, and its young remain in the "forage fish size class" through their first year. These characteristics will be discussed in detail in the sections to follow.

FEEDING HABITS

The intestinal tract is long and convoluted. For example, the intestine of a 17-inch female was 108 inches in length.

The stomachs and intestines of 10 adult blackfish collected in February, 1949, were examined. The stomachs were empty, but the full intestines contained diatoms, entomastrocan eggs, entomastraca, colonial green algae, rotifers, colonial blue-green algae, filamentous blue-green algae, filamentous green algae, desmids, detritus, and occasionally fine sand. These materials suggest that the adults feed on a combination of plankton and bottom materials. No evidence of selection of animal matter was seen, the general picture suggesting that plant matter and animal matter were ingested in about the same proportions as encountered. This means, of course, a preponderance of vegetable matter.

It should be noted that some of the organisms (diatoms and rotifers) are extremely minute. They key to the ingestion of them lies in the gill rakers. The mass effect of the rakers is shown in Figure 31. Figure 32 shows a cross section through the first gill arch. From a single base the rakers branch into multiple strands which together produce a broom effect. The series of brooms arranged lineally on the arch, closely pressed together, form a most efficient straining device. Figure 33 shows a small segment of one of the rakers magnified 50 times.

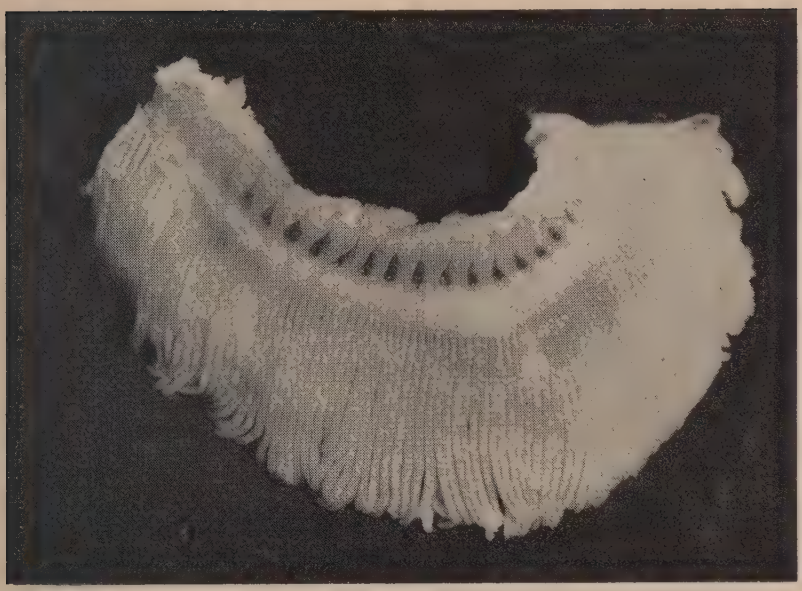

FIGURE 31. First gill arch from a 16.5 inch greaser blackfish.
Photograph by McCloud Photo Service

FIGURE 32. Cross section through the center of the first gill arch of a 16.5 inch greaser blackfish. *Photograph by McCloud Photo Service*

FIGURE 33. Branch of a gill raker from a 16.5 inch greaser blackfish, magnified 45 times. *Photograph by Garth I. Murphy*

The intestinal tracts of 25 young from 1.6 to 6.8 inches in length were examined. These specimens were collected during June, July, August, and September of 1949. No seasonal trend in food was detected, but young under 3 inches in length appeared to be partially selective, though the materials ingested were similar to those taken by adults. One individual would contain mainly fragments of Cladocera, another mainly colonial green algae. Some had fed largely on minute midges, and others on detritus, diatoms, and filamentous algae. Fine sand in the guts of many indicate that they were foraging on bottom material. The 11 specimens above three inches in length appeared to have fed indiscriminantly on the food available, and showed no evidence of selection, duplicating the picture presented by the intestines of the adults.

With respect to feeding habits the blackfish appears to occupy the same niche as the gizzard shad *(Dorosoma smathi)*. This fish is common east of the Rockies, and is a valuable forage species. According to Tiffany (1921, a, b) shad from .6 of an inch to 3 inches in length consume animal and plant plankton in about the same proportions as are present in the water. This is probably also true of the blackfish. Like the blackfish the older gizzard shad feed to a considerable extent on the bottom. The food of the gizzard shad is strained through numerous fine gill rakers instead of the relatively few highly branched rakers of the blackfish. Like the blackfish, young shad less than one inch long tend to feed selectively on animal plankton (Wickliff 1945).

SPAWNING HABITS

The spawning time of any fish is intimately connected with the temperature regime of the water. The temperatures of Clear Lake for the period bracketing spawning of the blackfish are given in Table 1.

Spawning blackfish were observed in Clear Lake four miles north of Lakeport on April 13 and 14, 1949. There were eight fish in the group. The males appeared black and the females olive in color. A female would work through short (1 to 6 inch) plant material at a depth of about three feet. A male would follow, either a few inches behind or alongside, apparently fertilizing the adhesive eggs. Some of these eggs were collected and hatched in an aquarium. They hatched in 14 days at a mean temperature of 58 degrees F. The extremes were 72 degrees and 39 degrees. Very possibly the eggs hatched more rapidly in the lake, since its night temperatures were higher than those in the outdoor aquarium.

The spawning period is quite protracted, judging from the fact that spawning females were taken as late as June 23, 1947. This probably causes the great variation in size of young of the year. It is not known whether the blackfish typically spawn in small groups, such as that observed. Normally, visibility along the shores of Clear Lake is so limited that nothing can be seen, making opportunities to view spawning fish rare.

TABLE 1

Temperatures in Clear Lake 1949. Records From a Thermograph With the Bulb Located Just Offshore in Four Feet of Water

Date	Temperature			Date	Temperature			Date	Temperature		
	Minimum	Maximum	Mean		Minimum	Maximum	Mean		Minimum	Maximum	Mean
Feb. 10	41	49.5	45.3	Apr. 3	51	59	55.0	May 18	63	65	64.0
11	42	49.5	45.8	4	55.5	61	58.3	19	62.5	65.5	64.0
12	41.5	50	45.8	5	54.5	59	56.8	20	62	63.5	63.8
13	45	48	46.5	6	55	62	58.5	21	61	69	65.0
14	45	46	45.5	7	55	60	57.5	22	62	68	65.0
15	45	47.5	46.3	8	54	59	56.5	23	62	67.5	64.8
16	45	50	47.5	9	53	60	56.5	24	62	75.5	68.8
17	48	52	50.0	10	54.5	62	58.3	25	64	78	71.0
18	46	53.5	49.8	11	55.5	64.5	60.0	26	64	72	68.0
19	48	50.5	49.2	12	55	64	59.5	27	63	69	66.0
20	47	55	51.0	13	56	63.5	59.8	28	62	69	65.5
21	49	52	50.5	14	57	66	61.5	29	63	65	64.0
22	47.5	49	48.3	15	60	68	61.5	30	63	70	66.5
23	47	48	47.5	16	61	65	63.0	31	64.5	67	65.8
				17	60	67	63.5				
Mar. 4	45	47	46.0	18	57.5	64	60.8	June 1	63.5	70.5	67.0
5	44.5	47	45.8	19	54.5	58	56.3	2	64	73	68.5
6	45.5	50	47.3	20	54.5	58	56.3	3	68	72.5	70.3
7	47	51	49.0	21	57	63	60.0	4	68.5	74.5	71.5
8	47	52	49.5	22	57.5	67	62.3	5	70	75	72.5
9	46	50	48.0	23	60	62	61.0	6	68	74.5	71.3
10	46	47	46.5	24	59	63.5	61.3	7	67	76	71.5
11	45	46	45.5	25	59	66	62.5	8	71	78.5	74.3
12	45	49	47.0	26	60	68	64.0	9	70	76	73.0
13	46.5	50	48.3	27	60	65	62.5	10	68.5	76	72.3
14	48	49	48.5	28	60.5	62.5	61.5	11	68.5	79	73.8
15	48	49	48.5	29	59	61	60.0	12	71.5	83	77.3
16	48	50	49.0	30	59	62	60.5	13	74	79.5	76.8
17	49	50	49.5					14	73	81	77.0
18	50	51.5	50.8	May 1	59	63.5	61.3	15	75.5	83	79.3
19	49	51.5	50.3	2	60.5	61.5	61.0	16	76.5	80	78.0
20	48	53	50.5	3	59	63.5	61.3	17	75	79.5	77.8
21	49.5	53	51.3	4	59.5	65.5	62.5	18	72	74.5	73.3
22	49	50	49.5	5	60	66.5	63.3	19	70	76.5	73.3
23	48	50	49.0	6	63	68	65.5	20	------	------	------
24	49	53	51.0	7	62	69	65.5	21	------	------	------
25	51	55	53.0	8	62	64.5	63.3	22	------	------	------
26	50	52.5	51.3	9	61	69	65.0	23	------	------	------
27	51	53	52.0	10	63.5	73	68.3	24	------	------	------
28	50	53	51.5	11	64	68.5	66.3	25	------	------	------
29	51	56.5	53.8	12	63	68.5	65.8	26	------	------	------
30	50.5	53	51.8	13	64	74	69.0	27	------	------	------
31	51	54	52.5	14	67	70.5	68.8	28	------	------	------
				15	------	------	------	29	69	80	74.5
Apr. 1	50	54.5	52.3	16	------	------	------	30	69.5	80	74.8
2	50.5	55	52.8	17	65	66.5	65.8				

The blackfish is very prolific. A 17.0-inch specimen contained an estimated 350,000 eggs.

Judging from scale samples most blackfish spawn at the end of their third year, with a few individuals spawning at the end of their second year. Most adults taken showed evidence of only one prior spawning. The samples from the commercial fishery were mainly ripening fish nearly ready to spawn for the second time. Since large numbers of ripening fish that had spawned once were taken, and almost none that had spawned twice, it seems safe to conclude that most blackfish die after a second spawning. This conclusion is reinforced by the presence of numbers of dead adult blackfish in the lake during and after the spawning period.

POSTLARVAL LIFE

After hatching the young blackfish occupy the littoral zone of the lake. Small schools of fry are readily found along the shore during late April and May. The young continue to occupy the shore area through their first summer, gradually becoming fewer in number. Most of this reduction is probably due to predation, though diseased and dying individuals have been seen. During their first winter they disappear from the shoal areas and apparently do not return until they spawn. This conclusion is based on the absence, with one exception, of blackfish intermediate between spawning adults and young of the year from several hundred fine mesh seine hauls along the shore line.

The growth of young of the year through their first summer is illustrated in Figure 34. To this diagram is added a collection of yearlings to illustrate the growth over the first winter and spring.

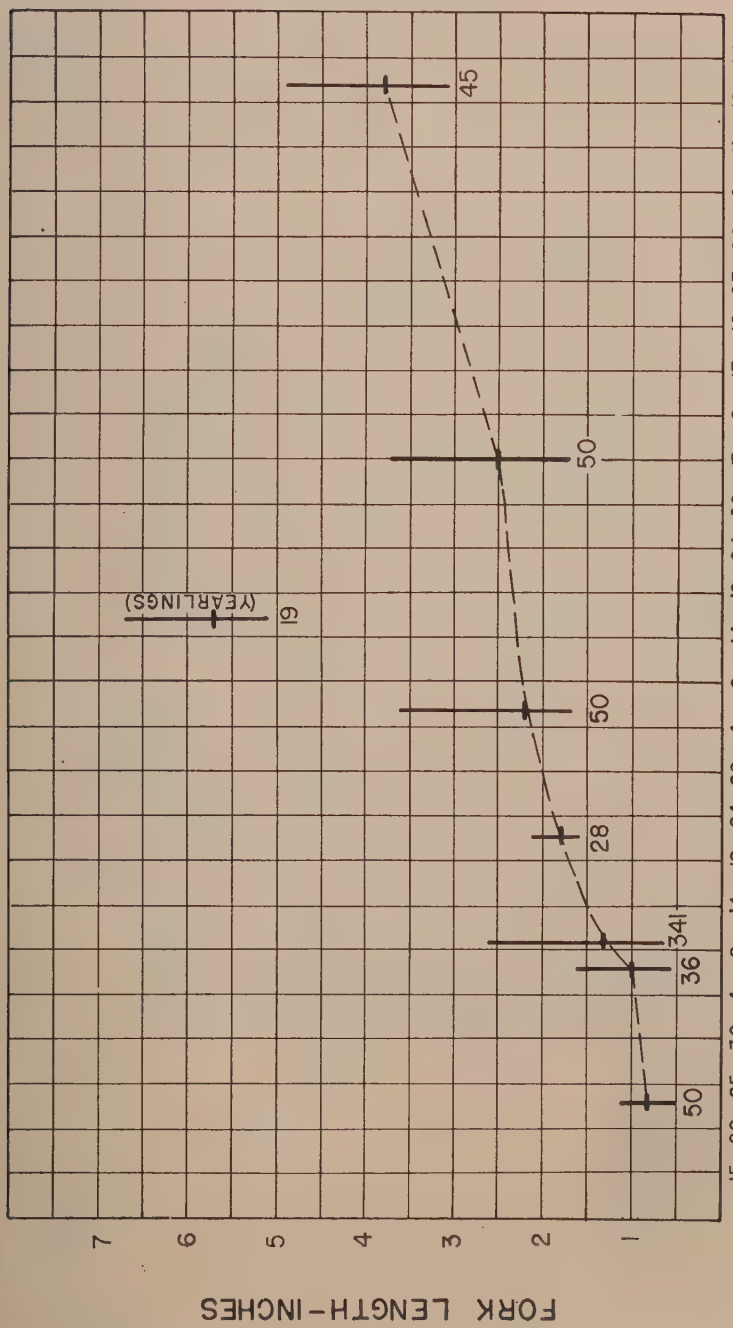

FIGURE 34. Range and mean length of samples of blackfish of the year from Clear Lake. The numbers beneath the bar are the sample sizes

GROWTH RATE

This discussion is based on a study of 139 sexed scale samples. The scales were taken between the dorsal fin and the lateral line. A typical scale is illustrated in Figure 35.

FIGURE 35. Scale from a 15.0 inch male blackfish. This fish has completed its fourth year of growth and evidently spawned at the end of its third year

The distance from the scale center to each annulus was measured with a dial micrometer attached to a mechanical stage. The length of the fish at each annulus was calculated by the direct proportional method. No difficulty in identifying the first annulus was encountered. It was generally followed by circuli more widely spaced than those characterizing the first year's growth; these circuli probably represent a period of more effective food intake coupled with warmer spring temperatures.

The second annulus was often difficult to locate. Apparently this is due to a combination of only slight winter retardation of growth and lack of spawning retardation at the end of the second year. The third annulus, reinforced by a spawning check, was readily identified. There is some danger in calculating the length of a fish from the center to the third annulus, since considerable scale resorption was evident. This difficulty was overcome to some extent by measuring the field showing the least

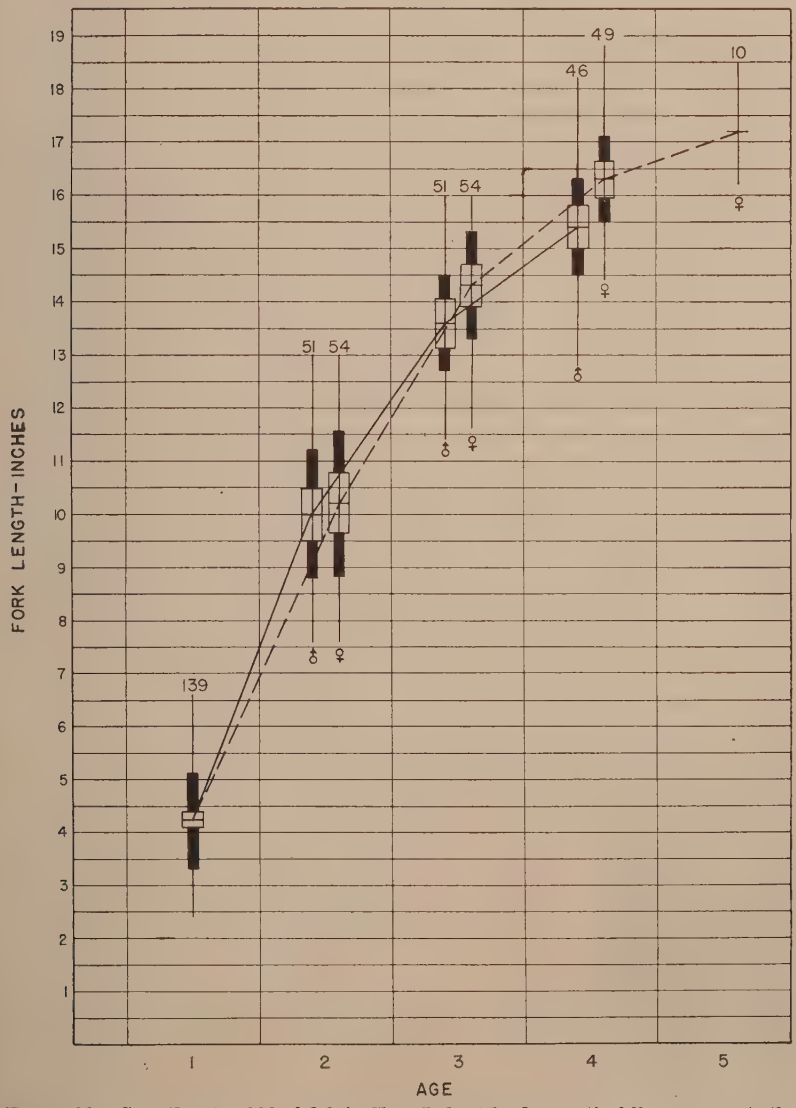

FIGURE 36. Growth rate of blackfish in Clear Lake. The fine vertical line represents the range, the heavy vertical line on standard deviation from the mean, and the double box three times the standard error of the mean

resorption. In most cases the edge of the scale was considered to be the fourth annulus, since the samples were all taken in the spring during or just before the spawning season, when apparently the annulus is formed. Of the 54 adult females studied, 10 were at the end of their fourth year, or at age 5. Only five of these fish had spawned twice before, during the preceding two years. One of the remaining spawned at age 3, and not at

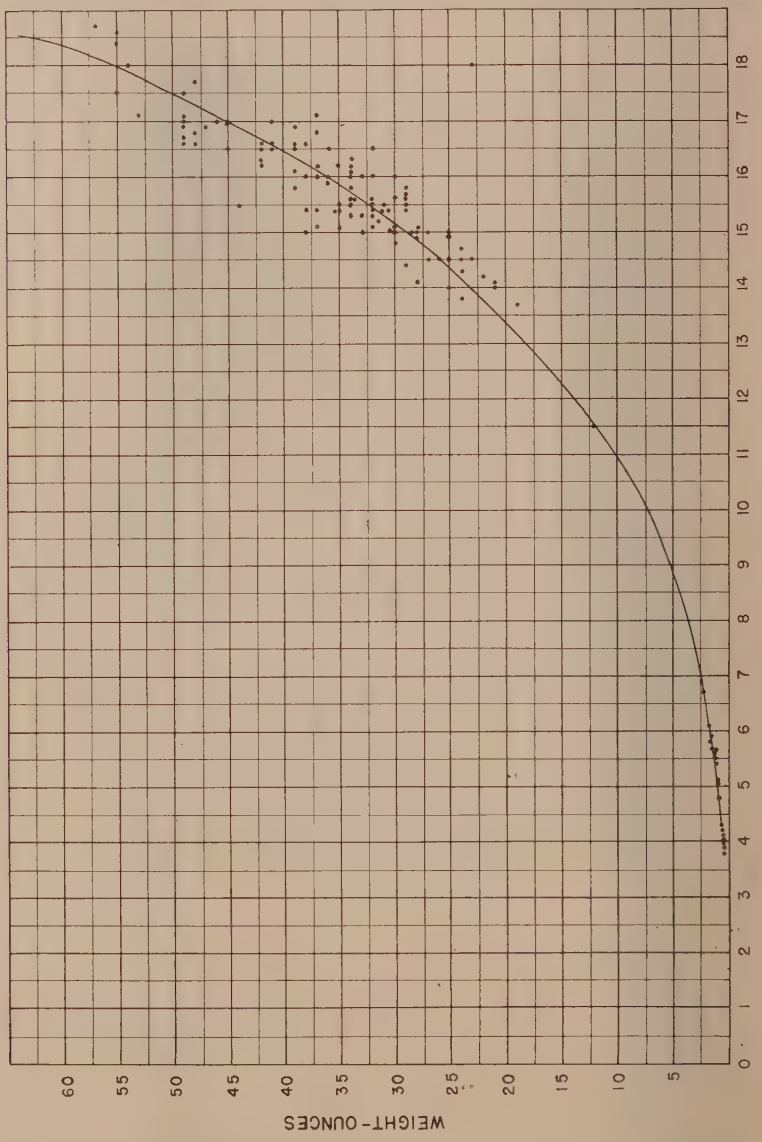

FIGURE 37. Length-weight of greaser blackfish in Clear Lake

age 4; and four spawned for the first time at age 4. Of 50 males, none had spawned more than once.

It will be noted from Figure 36 that the blackfish grows slowly during its first year, experiences its greatest gain in length in its second year, grows considerably in its third year, and grows relatively little after its first spawning. Females appear to grow more rapidly than males after the first year and so were separated in the graphic presentation.

THE COMMERCIAL FISHERY

There has long been a small but steady demand for blackfish in California. The trade is largely in the spring, and the consumers are mainly orientals. Until 1948, when the taking of blackfish was prohibited, Clear Lake supplied the bulk of the Northern California trade. The fish were captured by seining together with carp. The blackfish were held in live cars and taken by tank truck to San Francisco, where the fishermen received about $0.30 per pound. The wholesaler kept the fish alive in tanks, and the retailer kept his supply in tanks, the consumer receiving his fish alive and flopping. Catch statistics for Clear Lake are given in Table 2. Length data on several samples from the commercial fishery take at Clear Lake are given in Table 3.

TABLE 2

Commercial Catch of Blackfish, Clear Lake, in Pounds

Year	Clear Lake	Year	Clear Lake
1932	[1] 268,242	1941	82,000
1933	132,360	1942	158,600
1934	91,540	1943	39,200
1935	65,465	1944	40,600
1936	68,400	1945	44,304
1937	20,739	1946	19,982
1938	4,164	1947	20,644
		1948	51,148

[1] Approximate conversion to numbers obtained by dividing the weight by 2.

TABLE 3

Samples of the Commercial Catch of Blackfish, Clear Lake
Fork Lengths in Inches

Location	Date	Number	Maximum	Mean	Minimum	S.D.[1]	S.E.[2]
Clear Lake Oaks	Jan. 11, 1946	63	18.7	17.1	15.2	0.79	0.10
Clear Lake Oaks	Mar. 10, 1947	50	17.9	16.7	14.6	0.77	0.19
Clear Lake Oaks	Mar. 13, 1947	50	19.5	16.3	14.6	0.91	0.13
Clear Lake Oaks	Mar. 26, 1943	26	17.5	15.6	14.0	0.76	0.15
Rodman Slough	Mar. 26, 1943	60	16.6	15.2	14.0	0.72	0.09
Long Tule Pt.	May 6, 1948	30	17.3	14.8	13.4	0.81	0.15

[1] Standard deviation.
[2] Standard error.

The commercial fishery preyed mainly upon prespawning concentrations of adults. The most probable explanation for the varying size of the individual samples is that the schools may be comprised of varying proportions of males and females. It should be noted that the commercial

catch is made up almost exclusively of fish at the end of their fourth year. Apparently the mesh size used allowed the age 3 spawners, with the exception of a few individuals, to escape.

DISCUSSION

Viewing the blackfish from the point of management of warm-water fisheries, it is evident that it may be very useful. It converts the basic food materials of the lake directly into flesh without long intermediate stages. It does not compete with game fish for spawning grounds, and with the possible exception of the young, does not compete for food. Some slight competition might develop in some waters between young blackfish and young game fish for food. One major field of competition remains, and that is competition for space. This will probably affect the game fish populations only when the physical environment is extremely favorable for blackfish, and unfavorable for game fish. Such a favorable ecological situation might permit blackfish to "crowd out" game fishes. This was probably the situation in Lake Hughes in Los Angeles County, where blackfish appeared to have overrun the lake. (Blackfish were eliminated from Lake Hughes and nearby waters by chemical treatment in 1949.)

The blackfish grows more rapidly than the "ideal forage fish," but remains in the forage fish class during its first year. In Clear Lake it is an important forage fish, but alone does not appear to satisfy the demand. Murphy (1949) found young blackfish to be the most important fish food of young bass of the year during midsummer. He found that although young bluegill appeared more numerous, the bass were utilizing blackfish to a much greater extent. This was thought due in part to greater palatability of blackfish, but chiefly because blackfish stay in open water, while bluegill tend to seek cover. In order to increase the supply of young blackfish, commercial fishing for them in Clear Lake was halted in 1948.

Another characteristic increasing the blackfish's effectiveness as a forage fish is its early spawning, coinciding more or less with that of the largemouth black bass. In many waters the bass fry are the first to emerge and must for a time bear the brunt of the demand for small fish. The blackfish, hatching at the same time, must decrease the predation on young bass by a buffering effect.

In 1949 blackfish were planted in East Park Reservoir, Colusa County, in an effort to improve a very poor forage fish supply. They should spawn well ahead of the drawdown of the reservoir, a factor that probably prevents successful bluegill reproduction. Further, they will not be dependent for food on insects, which are notoriously lacking in fluctuating reservoirs.

SUMMARY

The greaser blackfish is a cyprinid native to the Sacramento-San Joaquin and Pajaro River drainage systems. Specimens from 1.6 to 3.0 inches in length appear to feed selectively on animal plankton, small midges, algae, etc., the selection varying from individual to individual. Fish over three inches long feed on plant and animal plankton, bottom detritus, and diatoms. These minute foods are extracted by brushlike branching gill rakes. Spawning takes place in April, May, and June. The eggs are adhesive and are placed on plant material at a depth of about

three feet. A 17.0-inch female contained approximately 350,000 maturing eggs. The majority first spawn at the end of their third year and most fish die after their second spawning.

Young blackfish occupy the littoral zone during their first summer. After their first year they leave the shore and do not return until they spawn.

At age 1, blackfish are 4.3 inches long; at age 2, males are 10.0 inches long, females 10.2; at age 3, males are 13.6 inches long, females 14.3; at age 4, males are 15.4 inches long, females 16.3; at age 5, females are 17.2 inches long.

Prior to 1948 there was a commercial fishery for blackfish in Clear Lake, the fish being marketed alive in San Francisco. The fishery was stopped in order to increase the forage fish supply of the lake.

The blackfish may prove useful as a forage fish in other waters, particularly fluctuating reservoirs.

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STRIPED BASS REPRODUCTION IN THE SACRAMENTO RIVER SYSTEM IN 1948[1]

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It is only recently that a fairly adequate general picture of the spawning and early life history of the striped bass, *Roccus saxatilis* (Walbaum), in California has been obtained. The great economic importance of this species justifies extensive exploration along these lines by a state agency like the Division of Fish and Game, since a fishery cannot be understood and managed to the best advantage unless the life history of the fish is known in some detail.

The matter is also of immediate practical concern because of the mammoth diversions being built or contemplated for construction on the Central Valley rivers which serve the bass as spawning and nursery grounds. Losses of small fish at these diversions can be minimized only if we know what to expect. An earlier report (Calhoun and Woodhull, 1948), which summarized studies of striped bass reproduction during 1947, discussed these diversions and associated problems in some detail.

The whole matter of striped bass spawning in the Sacramento River system remained a wide-open question at the end of the 1947 studies. The area was believed to be quite important, at least in some years, but the evidence to support this view was fragmentary and uncertain. This was one of the principal reasons for concentrating effort there during 1948.

It will be desirable at this point to outline briefly the background which gave rise to the 1948 program and was largely responsible for the shape it took. The Delta-Mendota Pumping Plant, under construction at the south end of the San Joaquin Delta, presented a possible serious threat to the future welfare of the striped bass population. It will divert large amounts of water from important striped bass nursery grounds, and it was clearly possible that losses of small fish sucked up with the water might be great. However, no reasonable prediction of the expected magnitude of such losses was possible, because of the many unknown factors involved. Studies during 1947 had indicated that fry originating in the Sacramento River system would be in somewhat less danger from this big diversion than those spawned in the San Joaquin Delta. A relatively large proportion of Sacramento River fry can be expected to flush rapidly down into Suisun Bay, beyond the influence of the pumps, whereas those spawned in the San Joaquin Delta will tend to remain trapped there by tidal currents. The pumps will draw upon this Delta as a huge reservoir, to the peril of any small bass which might be present.

A quantitative determination over a period of years of the relative importance of the various striped bass spawning grounds would obviously be of great help in evaluating the whole situation. However, such a project was entirely beyond our scope in 1948. Moreover, it seemed very

[1] Submitted for publication January, 1950.

doubtful that results which could be anticipated from large-scale studies of the distribution and abundance of striped bass eggs and larvae in the Delta would justify their cost, particularly inasmuch as they would have to continue over a period of many years to reveal annual variations in the picture, which are probably great.

An alternative approach, and one which was not only within our reach but also promised to yield valuable information, was to make a detailed study of spawning in the poorly understood Sacramento River.[1] Accordingly, field studies during the 1948 spawning season were centered there. They had three main objectives. The first was to increase our general knowledge of the life history of the striped bass, and much was accomplished in this direction. The second was to obtain quantitative estimates of discharges of striped bass eggs and larvae from the Sacramento River system to the Delta, and in this we were unsuccessful. The third objective was to explore the whole matter of the feasibility and desirability of a large-scale, quantitative study of striped bass spawning over a period of years, and it was finally concluded in this connection that such a project was impractical and could not be justified because of tremendous cost and questionable results. It must be emphasized at this point, to avoid any possibility of creating an erroneous impression, that this conclusion does not in any way apply to annual studies of striped bass fry on the nursery grounds during the summer. We hope to learn a great deal with a reasonable expenditure of effort from a continuing study of their abundance each year.

Before discussing our 1948 program it will be well to provide a background of pertinent facts about striped bass reproduction. The spawning season of this fish in California normally centers in May. It extends from about late March to early July, varying somewhat from year to year with seasonal conditions. The bass spawn at the surface, in fresh water, at places where there is a current. After the eggs are fertilized they swell rapidly by absorbing water and become semibuoyant. Any slight current will sweep them up and carry them along. As a result, they pass rapidly down the rivers when the latter are high and swift, as they were in the spring of 1948. It was therefore readily possible that year to sample the rivers for the eggs which were present, using nets to strain them from the water. The tiny larvae which emerge from the eggs in two or three days may also be collected in this way, as they behave similarly.

The nets we used were cone-shaped, with a mouth diameter of 19 inches. The straining surface was silk bolting cloth having 30 meshes to the inch. The small size of the newly emerged larvae made this very fine mesh necessary. Quart mason jars tied at the small end of the net served as collecting bottles. Samples were preserved in these jars, by the addition of formalin, and were kept in them until sorted. They were always preserved before sorting, because this rendered the eggs and larvae opaque and therefore more readily visible.

The standard procedure in taking a sample was to lower a net into a river from a bridge, in the middle of the channel, keeping it submerged just beneath the surface for 15 minutes. A chain leader was usually

[1] During 1948 the U. S. Fish and Wildlife Service conducted a large-scale study of the distribution of fish eggs, larvae and fry in the San Joaquin Delta. Their report on this work is scheduled for early publication.

necessary to keep the net entirely in the water, because of the strong lifting action of the river currents.

Sampling was carried on at the four stations shown in the orientation map, Figure 38. The Freeport station was selected as the most suitable place for measuring the flow of eggs from the whole Sacramento

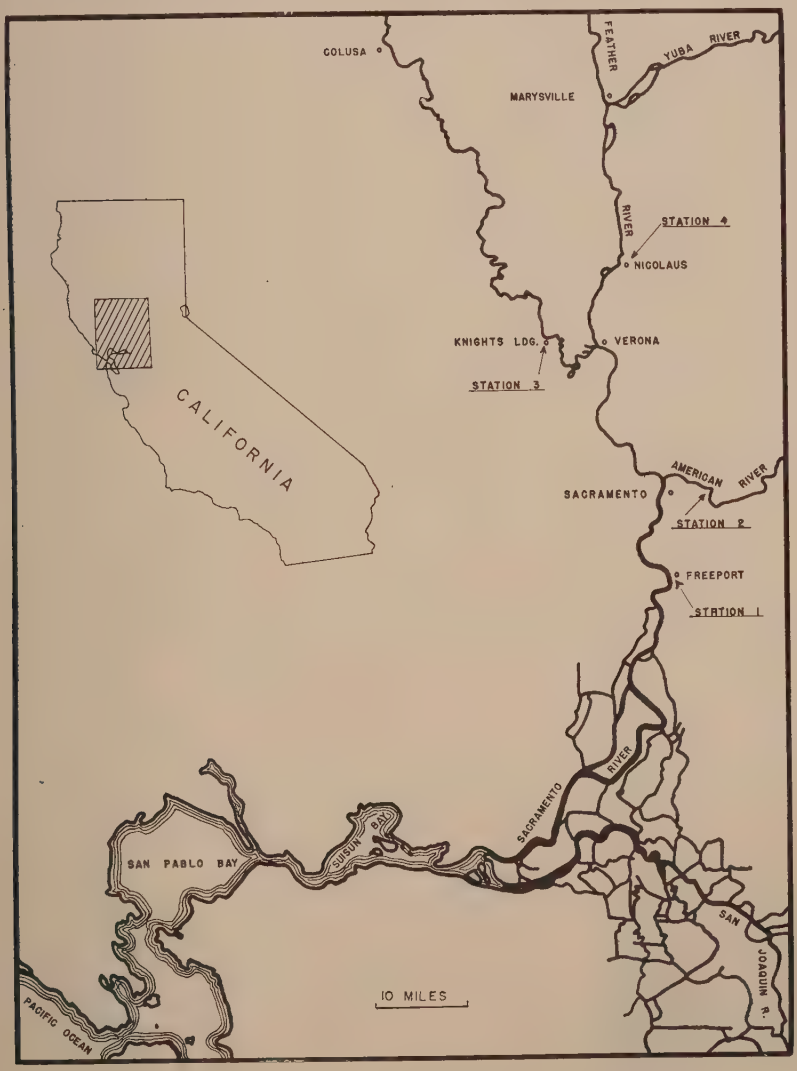

FIGURE 38. Orientation map of the Sacramento River system, showing location of the 1948 stations

River system to the Delta. The other three stations were located on the bridges nearest the mouths of the Sacramento's important lower tributaries, so that their individual contributions could be evaluated. Bridges

were resorted to for sampling after preliminary trials with boats proved unsatisfactory. As the rivers became very high, in mid-April, rowboat operation became hazardous and unreasonably time-consuming.

The four stations were sampled as frequently as practicable, in order to obtain a fairly complete picture of the occurrence of striped bass eggs and larvae at these key points. Only two men were available to do the sampling at any one time, and it was therefore necessary to resort to a "hit-and-run" type of operation in order to cover the necessary ground. The Freeport station was manned permanently by Johnson, who collected as many samples each day at regular intervals as he could examine. The other three stations were sampled during alternate three-day periods by Calhoun and Woodhull, who traveled more or less continuously from one to another, sampling them in rotation.

The problem of distinguishing striped bass eggs and larvae from those of other fishes present in the samples was relatively simple, since they have been described and figured in detail (Pearson, 1938) and are unlike those of other fishes in the area. One other type of fish egg was particularly abundant in the Sacramento River plankton over a period of many weeks. It usually far outnumbered the bass eggs. Although no careful study of the matter was attempted, inference from limited evidence suggests that it may belong to the splittail (*Pogonichthys macrolepidotus),* a large native member of the carp family.

Sampling was begun at Freeport on April 1st, since 1947 observations had indicated that striped bass eggs might be expected in the river at any time after that. However, the weather was generally colder in the spring of 1948 than it had been in 1947 and as a result the start of the striped bass spawning season was delayed about one month. The sampling record for the Freeport station is summarized in Table 1. The final column of this table provides a rough index of the relative abundance of striped bass eggs at different times during the sampling period, which extended from April 1st to June 9th. These figures are graphed in the bottom panel of Figure 39. It will be noted that the vertical scale of this particular graph is considerably greater than in the two above it, because of the lower recovery rates at Freeport. It will also be seen in Figure 39 that the base lines are variable in thickness. The fine sections represent days upon which no samples were collected, whereas the heavier sections indicate those upon which all samples were negative.

The Sacramento River was wide and deep at Freeport during the sampling period. Daily mean flows ranged from 30,000 to 70,000 cubic feet per second (Calif. Div. Water Res., 1949). The river was sounded on April 1st, when the flow was 30,000 c.f.s., and found to be 20 feet deep in mid-channel. Of course, with increased flows it became much deeper. During the period when striped bass eggs were being recovered flows ranged from 38,500 to 59,000 c.f.s., and current velocities were from three to three and a half feet per second. Water temperatures, shown in Table 1, ranged from 49° to 63° F.

The first striped bass egg was recovered at Freeport on May 11. Eggs were taken there on 12 of the 21 subsequent sampling days, as can be seen from the bottom graph in Figure 39. They were present in some numbers on June 9th, the final day of sampling, and there is little doubt that they occurred for some time after sampling ceased. The entire program was discontinued on June 9th because the main questions which

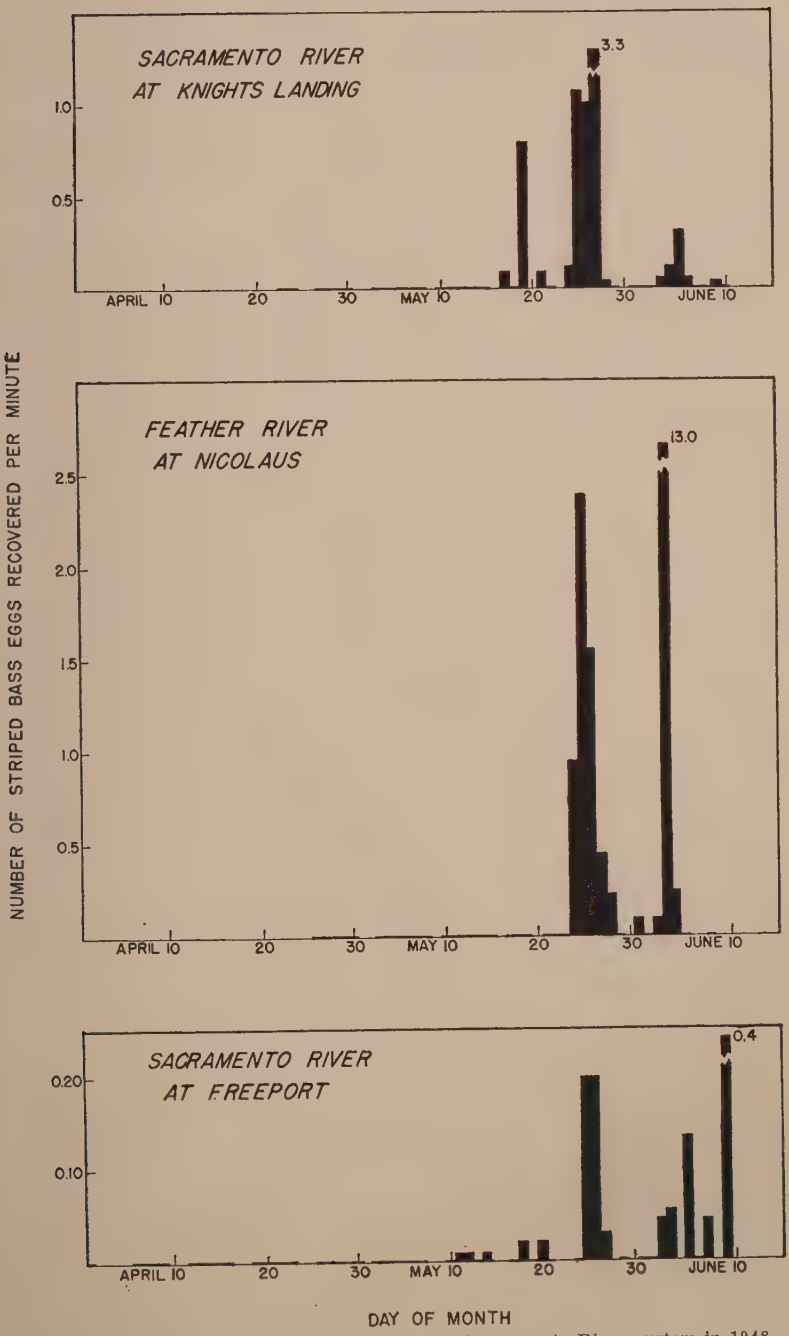

FIGURE 39. Striped bass egg sampling in the Sacramento River system in 1948

TABLE 1

Record of Sampling and Striped Bass Eggs Taken at Freeport

Date	Water temperature [1]	Number of samples [2]	Striped bass eggs [3]	
			Number	Number per minute
April 1	56°F.	4	0	0
6	54	8	0	0
7	51	12	0	0
8	49	4	0	0
9	52	12	0	0
12	51	2	0	0
13	52	4	0	0
14	54	11	0	0
15	56	11	0	0
16	54	6	0	0
19	52	5	0	0
20	52	10	0	0
21	51	6	0	0
22	53	10	0	0
23	52	8	0	0
26	52	6	0	0
27	52	6	0	0
28	52	7	0	0
29	50	3	0	0
30	51	7	0	0
May 3	55	6	0	
4	58	7	0	0
5	58	7	0	0
6	60	6	0	0
7	57	6	0	0
10	58	6	0	0
11	58	6	1	0.011
12	57	6	1	0.011
13	59	6	0	0
14	59	6	1	0.011
17	59	6	0	0
18	57	6	2	0.022
19	56	6	0	0
20	56	6	2	0.022
21	56	6	0	0
24	59	6	0	0
25	61	6	18	0.200
26	63	9	27	0.200
27	59	6	3	0.033
29	60	1	0	0
31	58	1	0	0
June 1	60	6	0	0
2	60	6	4	0.045
3	60	5	4	0.053
5	60	1	2	0.134
6	60	1	0	0
7	60	3	2	0.045
9	63	3	17	0.4

[1] Maximum surface temperature noted during the day, taken in the quart jar containing the sample immediately after removing it from the river.

[2] Fifteen-minute samples with a half-meter, 30-mesh-per-inch plankton net, fully submerged, with the top of its mouth at or near the surface.

[3] Only a single striped bass larva was collected in all of this sampling. It was taken on May 27th.

had prompted the study had been answered as fully as a survey of this sort could be expected to answer them.

One of the notable things about the Freeport samples was the relatively low rates of recovery compared with the stations at Nicolaus and Knights Landing, discussed below. The discharge of some 10,000 c.f.s. of barren American River water into the Sacramento a few miles above Freeport was undoubtedly a factor. Hatching of the eggs released further up the river may also have played a part, although this is uncertain, because only a single striped bass larva was recovered at Freeport in 1948, although those of other species were not uncommon. It is possible that most of the larvae were well below the surface, and were therefore

unsampled, although this is also far from certain, considering the high current velocities involved. In 1947, when the rivers were much lower and warmer, striped bass larvae were abundant in the Sacramento many miles above Freeport during mid-April. There is probably great variation in the general picture of striped bass reproduction in this river system from year to year.

One of our original objectives had been to obtain a quantitative estimate of the number of striped bass eggs and larvae passing down the Sacramento River into the Delta in 1948. This had to be given up, however, as it became increasingly apparent that quantitative results were beyond our reach because studies of the vertical distribution of eggs and larvae in the river proved impractical. The current velocities which developed there necessitated the use of heavier gear than we could muster on short notice. In the absence of accurate information about vertical distribution it is, of course, impossible to convert our surface samples into quantitative terms. Other important factors also remain unevaluated, such as the possible breakage of large numbers of the very delicate eggs in the nets through the action of the strong currents in a confined space. Conversion of the rates of egg capture outlined in the last column of Table 1 to estimates of numbers of eggs passing Freeport during a 24-hour period, on the basis of the proportion of the total flow actually sampled, yielded very low figures, of the order of 1,000,000 eggs per day. We do not believe they represent an accurate picture of the situation.

Next, let us turn our attention to the station on the American River, also shown in Figure 38. It was located on the "H" Street Bridge, six miles above the mouth of the American River. Daily mean flows here ranged from 7,300 to 15,600 c.f.s. between April 22d and June 8th, the sampling period. Not a single striped bass egg or larva was obtained, although 30 samples were taken on 24 different days. The water temperatures remained consistently low. They reached 59 degrees only once on the days observed. In all probability this accounts for the absence of eggs, for usually they were not taken at other stations until water temperatures reached about 60 degrees F. This river appears to have been of little or no importance as a striped bass spawning area during 1948, although it is, of course, possible that some spawning occurred after sampling ceased on June 8th.

Results of sampling at the other two stations, at Nicolaus and Knights Landing, are particularly interesting, because they throw light on the water temperatures and weather conditions under which the bass will spawn. Nothing of this sort could be inferred from the Freeport samples because they represent an aggregate of eggs from a number of diverse sources.

Sampling of the Feather River at Nicolaus was begun on April 26th. The river here was very wide and shallow, and current velocities ranged from about $2\frac{1}{2}$ to $3\frac{1}{2}$ feet per second. Daily mean flows were between 13,500 and 25,200 c.f.s. during the sampling period. The record for this station is summarized in Table 2. The first striped bass eggs were collected May 24th, coincident with a sudden rise in water temperature to 61 degrees. It had not previously exceeded 58 degrees in our readings, and spawning apparently was held up by the low temperatures. Observation of angling catches in the area left no doubt that the river had been well populated with striped bass on the point of spawning for a number of weeks before

eggs were found. Eggs were subsequently taken fairly consistently until sampling stopped. The sample of June 3d, in which nearly 200 eggs were found, was something of a record. These egg recoveries at Nicolaus, outlined in the last column of Table 2, are graphed in the middle panel of Figure 39. The depression between the two very obvious peaks in this graph coincided with a severe storm which appears to have brought spawning to a virtual standstill both here and in the Upper Sacramento River, which will be discussed next.

No striped bass larvae were found in Feather River samples in 1948.

The Nicolaus station probably came the closest of the four to providing reasonably quantitative samples. The river was so shallow and the currents so swift that we usually obtained grains of sand and bits of mica in some numbers in the collecting bottle. The matter of a differential vertical distribution of eggs can therefore be ignored, and we feel moderately safe in presenting the estimates in Table 3. They indicate passage down the river of from two to ten million striped bass eggs per day over a 15-day period. Actual numbers were probably greater. It was assumed in deriving these estimates that the nets strained water as rapidly as it was passing down the river, and that all eggs survived the netting and were

TABLE 2

Record of Sampling and Striped Bass Eggs Taken at Nicolaus

Date	Water temperature	Number of samples	Striped bass eggs	
			Number	Number per minute
April 26		3	0	0
27		2	0	0
28		2	0	0
29	48°F.	1	0	0
30	50	1	0	0
May 3	58	1	0	0
4	58	2	0	0
5	56	1	0	0
6		1	0	0
7	56	3	0	0
8		1	0	0
10	56	2	0	0
11	56	1	0	0
12	58	2	0	0
13	57.5	1	0	0
14	57.5	2	0	0
15	57.5	2	0	0
17	58	2	0	0
18	56	2	0	0
19	53	2	0	0
21	55	2	0	0
22	54	2	0	0
23	52	1	0	0
24	61	2	29	0.96
25	62	3	107	2.37
26	62	2	47	1.56
27	58.5	1	7	0.46
28	58	2	7	0.23
29	56	1	0	0
31	58	2	3	0.1
June 1	60	2	0	0
2	61	2	3	0.1
3	58	1	196	13.06
4	59	3	11	0.24
5		1	0	0
8	62	1	0	0

TABLE 3

Estimated Flow of Striped Bass Eggs Down the Feather River Past Nicolaus During the 1948 Sampling Period

Five-day period starting	Mean river flow, second-feet [1]	Cross-sectional area of river, sq. ft. [2]	Eggs per minute of sampling [3]	Estimated flow of eggs past Nicolaus	
				Per minute	5-day period
May 21	15,400	5,500	0.67	1,800	13,000,000
May 26	16,400	5,700	0.56	1,600	12,000,000
May 31	14,600	5,400	2.66	7,200	52,000,000

[1] The mean of the five daily means (Calif. Div. Water Res., 1949, p. 74).
[2] Estimated from data supplied by the California State Division of Water Resources.
[3] The average of the daily rates during the indicated period.

found. Each of these assumptions may have been a source of error. However, being minimal, these estimates are of interest in spite of their shortcomings, since there is little doubt that at least this many eggs came down the Feather River.

Sampling of the Sacramento River at Knights Landing is covered in Table 4. Daily mean flows ranged from 11,000 to 19,000 c.f.s. during the period when eggs were being taken, and current velocities were in the neighborhood of three feet per second. The river here is relatively deep and narrow. The water temperatures at this station, shown in the second column of Table 4, are of particular interest. This river warmed up more rapidly than the Feather and reached 63 degrees F. temporarily as early as May 10th, although no eggs were taken until May 17th. Subsequently there were three peaks in the numbers of eggs collected, as can be seen from the top panel of Figure 39. As in the case of the Feather River, mentioned earlier, the depressions between these peaks coincided with severe storms during which water temperatures dropped sharply. Of course, it is impossible to say if it was the stormy weather conditions or the declining water temperatures which actually inhibited spawning activity. There is little doubt that one or the other was responsible. It will be noted from Figure 39 that the first Feather River peak coincided closely with the second one at Knights Landing. Apparently a rather general phenomenon was involved.

Another point of interest is the minimal temperature at which striped bass will spawn. The data from these two stations indicate that it is about 60 degrees F.

By way of summary, it can be said with assurance that striped bass eggs were present in considerable numbers throughout the lower Sacramento River system during late May and early June of 1948, except in the American River, from which they appear to have been absent. Minimal estimates of the numbers of eggs passing down the Feather River during a 24-hour period ranged from 2,000,000 to 10,000,000 over a period of 15 days. These estimates are probably appreciably smaller than the true numbers, for a variety of reasons. Quantitative estimates could not be derived for other locations.

The bass did not begin to spawn in these rivers until water temperatures reached about 60 degrees. Spawning ceased during storms, when water temperatures declined, and was resumed when the weather became fair and water temperatures rose.

TABLE 4

Record of Sampling and Striped Bass Eggs Taken at Knights Landing

Date	Water temperature	Number of samples	Striped bass eggs	
			Number	Number per minute
April 22		1	0	0
23		1	0	0
26		2	0	0
27		2	0	0
28		2	0	0
29	52°F.	1	0	0
30		2	0	0
May 3	57	1	0	0
4	56	2	0	0
5	56	2	0	0
6		1	0	0
7		2	0	0
8		2	0	0
10	63	2	0	0
11	59	2	0	0
12	61	2	0	0
13	59	1	0	0
14	59.5	2	0	0
15	60	2	0	0
17	61	2	3	0.1
18	61	3	0	0
19	62	4	48	0.8
21	58	2	4	0.1
22	57	1	0	0
24	64	1	2	0.13
25	65	2	32	1.06
26	64	2	30	1.00
27		1	49	3.26
28	65	2	1	0.03
29	63	1	0	0
31	62	1	0	0
June 1	61	2	0	0
2	61	2	0	0
3	62	2	2	0.06
4	63	2	4	0.13
5	62.5	2	10	0.33
6		1	0	0
7		3	3	0.06
8		2	0	0
9		2	1	0.03
10		1	0	0

Our general observations during 1948 have led us to the theory that the sexually mature striped bass travel upstream until they reach water of a suitable temperature for spawning, and that the more delayed such temperatures are in developing, the more the fish tend to work up out of the Delta into the tributary rivers to spawn. We have obtained the impression that when the Delta warms up early the bass spawn there and return quickly to salt water, whereas when the Delta remains cold, or is suddenly cooled during the spawning season, as happened in 1948, the fish continue up the rivers until they find more suitable conditions.

It must be emphasized that the above analysis remains a theory, although it is supported by some evidence. Angling was certainly far better in the Sacramento and Feather Rivers during the usual spring season in 1948 than in other recent years, even though these rivers were very high. The fish must therefore have been unusually abundant there that year. This fishery depends almost entirely on the spawning run. In 1947, when the rivers were very low and the Delta warmed up early, spring fishing in these rivers was very poor in comparison with 1948. Unfortunately, striped bass spawning takes place over such a wide area and during such a long period that it is well-nigh impossible to obtain

anything even approaching an adequate over-all picture of what is going on. We devoted so much of our attention to the Sacramento system in 1948 that our knowledge about what was going on in the San Joaquin Delta is very limited.

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THE LIFE HISTORY OF THE SACRAMENTO SQUAWFISH *(PTYCHOCHEILUS GRANDIS)* [1]

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California Division of Fish and Game

INTRODUCTION

The Sacramento squawfish *Ptychocheilus grandis* (Ayres) is one of four large western carps which make up the genus including the largest of the American Cyprinidae. *Ptychocheilus lucius* of the Colorado River attains the greatest size of the four. This species is reported by Jordan and Everman (1896-98) to reach a maximum weight of 80 pounds. *Ptychocheilus grandis* of the Sacramento-San Joaquin system, *Ptychocheilus umpquae* of the Umpqua River, Oregon, and *Ptychocheilus oregonensis* of the Columbia River system, and other streams as far north as the Fraser River of British Columbia, all have a reported maximum weight of about 15 pounds and a length of three feet.

Figure 40. Sacramento squawfish, *Ptychocheilus grandis* (Ayres)

Snyder (1908 and 1913) has differentiated the three latter species and defined their distribution in Oregon and California. The Sacramento squawfish is found in the Sacramento-San Joaquin drainage basin, the Russian River, and the Pajaro River system. It is also known by several unofficial common names: Sacramento pike, chappaul, hardhead, and whitefish.

GENERAL ECOLOGY

The squawfish is found in lowland and middle elevation streams, the area corresponding roughly with the Upper Sonoran and Transition life zones. At lower elevations it lives with black bass and catfish, and at middle elevations with trout. Through most of its range, the squawfish is

[1] Submitted for publication January, 1950.

abundant. Before the introduction of exotic species it was the co-dominant carnivore in the lowlands, sharing honors with the Sacramento perch. In the middle altitudes it competes with trout. Apparently the squawfish prefers streams typified by relatively warm water with ample pools. Though it occupies lowland lakes and sloughs as an adult, it seeks running water for spawning.

With the reduction in low-lying lakes and overflow basins in the Central Valley, it has declined in numbers. Cold water released from Shasta Dam on the Sacramento River has driven the squawfish from many miles of the stream, below the dam, in which it was formerly the dominant carnivore. In this same section trout have now become dominant. In Clear Lake, Lake County, squawfish were once enormously abundant. In the spring large numbers entered the tributary streams to spawn. They furnished a considerable sport fishery. The following quotation from the March 23, 1927 edition of the Lake County *Bee* will illustrate: "There is a good run of pike in Kelsey and Scott Creeks. The sport will probably last another two weeks. They are hard fighters second only to steelhead. A No. 2 brass spinner with pork rind is the best lure." This species is now practically extinct in the lake. Apparently a combination of heavy predation by largemouth black bass and other introduced species, and deterioration of the spawning and nursery streams, has brought about its near disappearance.

Many of California's smaller streams have become warmer through lower summer flows and reduced streamside cover. This change has been caused by erosion, diversion, heavy flooding, and fire. As a consequence of the changed physical conditions which now favor them, squawfish and other rough fish have displaced trout in many stretches of such streams, though without competition trout would survive in these stream sections.

Squawfish appear to partake in extensive local migrations. Periodic observations of the number of squawfish in Sulphur Creek, Sonoma County, were made at selected points from 1947 to 1949. Apparently large numbers of squawfish move into the creek from the Russian River in March and April. This movement applies to yearling fish as well as to large adults that have not spawned. They linger in the stream during the summer and retreat to the Russian River in the fall. However, not all individuals take part in this movement. A 22.5-inch male squawfish was captured in a large pool in Sulphur Creek on March 2, 1947, tagged and released. This fish was subsequently seen in the same pool on March 9, 1947; February 26, 1948; May 13, 1948; September 21, 1948; and September 2, 1949. When this fish was tagged there were about six adult squawfish in the pool and no young. Later in the season about 30 adults occupied the pool, and large numbers of "fingerling" squawfish could be seen, indicating that additional fish had moved into that section of the stream. The fact that the same tagged individual was seen in the same pool on the dates mentioned is a good indication that all individuals do not migrate, as it is almost inconceivable that it would partake in migrations and return to the same place in three successive years.

The migratory behavior of the squawfish has led to the suggestion that their numbers in a stream could be reduced by constructing a barrier to upstream migration, a barrier that would stop the squawfish but allow

migrating trout and steelhead to pass. Several specific proposals have been advanced by various biologists, and at least one experimental barrier will no doubt be constructed.

FOOD HABITS

A series of 36 stomachs from squawfish ranging from 1.3 to 7.0 inches in fork length was examined. These fish were taken by seining in the Russian River near Cloverdale on September 2, 1949. They had been feeding on aquatic insects, the smaller individuals taking tiny insect larvae, and the larger fish large insects. The specimens were captured on a large riffle, where they were probably feeding.

Two specimens, 10.5 inches and 12.5 inches long, captured by angling in Sulphur Creek on the same date, had empty stomachs, but it is significant that the only lure that would interest them was a small minnow. In addition to this, large squawfish have been observed capturing small fish at various times.

Two studies of the food of the Columbia River squawfish *(Ptychocheilus oregonensis)* are available. Chapman and Quistorff (1938) examined the stomachs of 95 squawfish (7.3 to 21.5 inches in fork length) from the Columbia River and the Wenatchee River. Only 37 of the stomachs contained food. Of these, 9 (24 percent) contained unidentifiable fish remains, and the rest aquatic insects. Ricker (1941) in a study of the species of fish preying on young red (sockeye) salmon *(Oncorhynchus nerka)* in Cultus Lake, B. C., found the squawfish to be an important predator. He found that young red salmon up to a year of age are the most important food of squawfish more than 4.5 inches long, except during the period from May to September. In the course of this study squawfish were netted several times as frequently as any other predator. These findings led to a systematic campaign against squawfish and other predators (Foerster and Ricker, 1941), reducing their numbers in 1938 to about 1/10 of their 1935 level. This increased the survival of red salmon from planted fry to downstream migrants by 3.1 times, and from eggs in female sockeye spawning naturally to downstream migrants by 4.4 times.

The data for the Sacramento squawfish and the Columbia squawfish strongly suggest that they compete for food with trout and prey on their young. A more subtle realm of competition is for space. All organisms require "living room," and it is apparent that a stream choked with squawfish, which occupy much the same niche as trout, does not offer much "living room" for trout.

It is entirely possible that reduction of the numbers of squawfish in a steelhead spawning and nursery stream such as Sulphur Creek would increase the production of downstream steelhead migrants by several times.

SPAWNING HABITS

The information available on the spawning habits of the Sacramento squawfish is sketchy. They spawn in streams. In the Russian River system spawning takes place in April and May. The eggs are adhesive and are attached to rocks or gravel. In larger streams groups of squawfish have been observed going through what appears to be spawning at the lower ends of pools, just above where they break into riffles. The

exact spawning behavior has not been observed. A run of 8 to 10-inch squawfish was seen spawning in a small stream tributary to Upper Blue Lake in Lake County on April 16, 1947. Riffle areas only were available. All that could be observed was that a female and one or more males were very active at the lower edge of a stone. Later the stone was found to have large numbers of eggs adhering to its lower side.

AGE AND GROWTH

This section is condensed from Taft (1928). Taft measured all specimens in standard length in millimeters. In order to convert standard length to fork length, a series of squawfish was measured. These measurements and their regression line are shown in Figure 41. The correlation (r) between standard length and fork length based on this set of data is 1.000. The formula for the regression line is:

Fork Length (inches) = .4418 standard length (mm.) + 0.12 (inches).

Since it was not possible to measure the specimens used in Taft's investigation, the conversion must be accepted with some reservations. In addition it was not possible to measure any specimens longer than 383 mm. (standard length). Consequently, the conversion of measurements of larger fish incurs the possible inaccuracies inherent in projecting a trend. In this case, though, it seems relatively safe.

Most of the fish used in this study came from Coyote Creek, a small stream which rises in the Mt. Hamilton range and flows into the southern end of San Francisco Bay. This stream is typical of many in California, in that for six months out of the year it has hardly a measurable flow of water. Fish during this period are confined to small, isolated pools, which are fed by an underground flow of water. Some of the effects of this reduced flow on the fish will become apparent in the pages to follow.

Figure 42 shows the mean monthly discharge, in second-feet, of Coyote Creek, near Madrone, during the year 1921. It will be noticed that the stream flow rises rapidly in November, reaches a peak in December and January, and then drops off rapidly until April 1st. From April until July the decrease is more gradual. From July to November the major portion of the river bed is dry, only isolated pools fed by underground water remaining.

All scale measurements of the smaller fish were made with an eyepiece micrometer and the scale measurements will be stated in units, each of which has a value of .036 mm. The scales of the larger fish from Sacramento were measured from photomicrographs and the length was converted into units. Scales for measurement were taken from an area between the dorsal fin and the lateral line.

Figure 43 shows a growth curve for the first year. The points indicated are median lengths, while the dotted lines indicate the extremes of each group. Points 1, 2, 3, and 4 are the median lengths of fish of the 1927 year class, while points 5, 6, and 7 are the median lengths of fish of the 1926 year class. This combination of fish of different year classes is not desirable, but it should be noted that there are no obvious discrepancies in the curve between points 4 and 5.

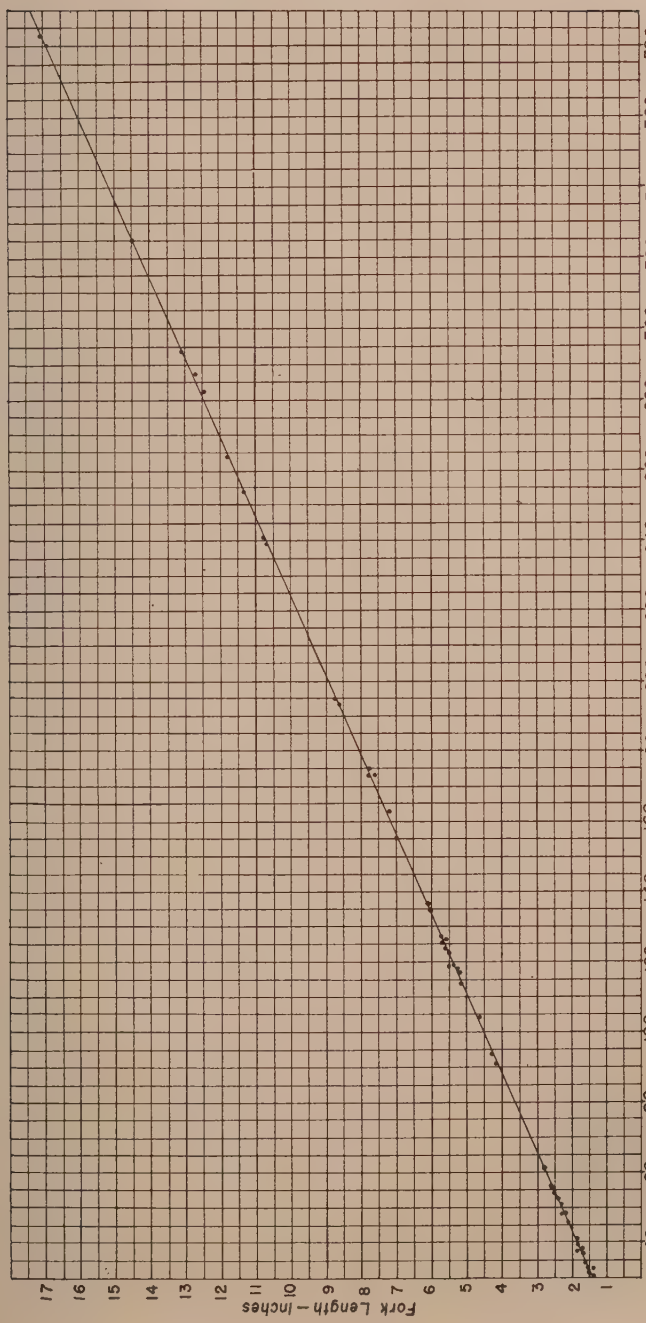

FIGURE 41. Regression line of fork length in inches and standard length in millimeters for the Sacramento squawfish

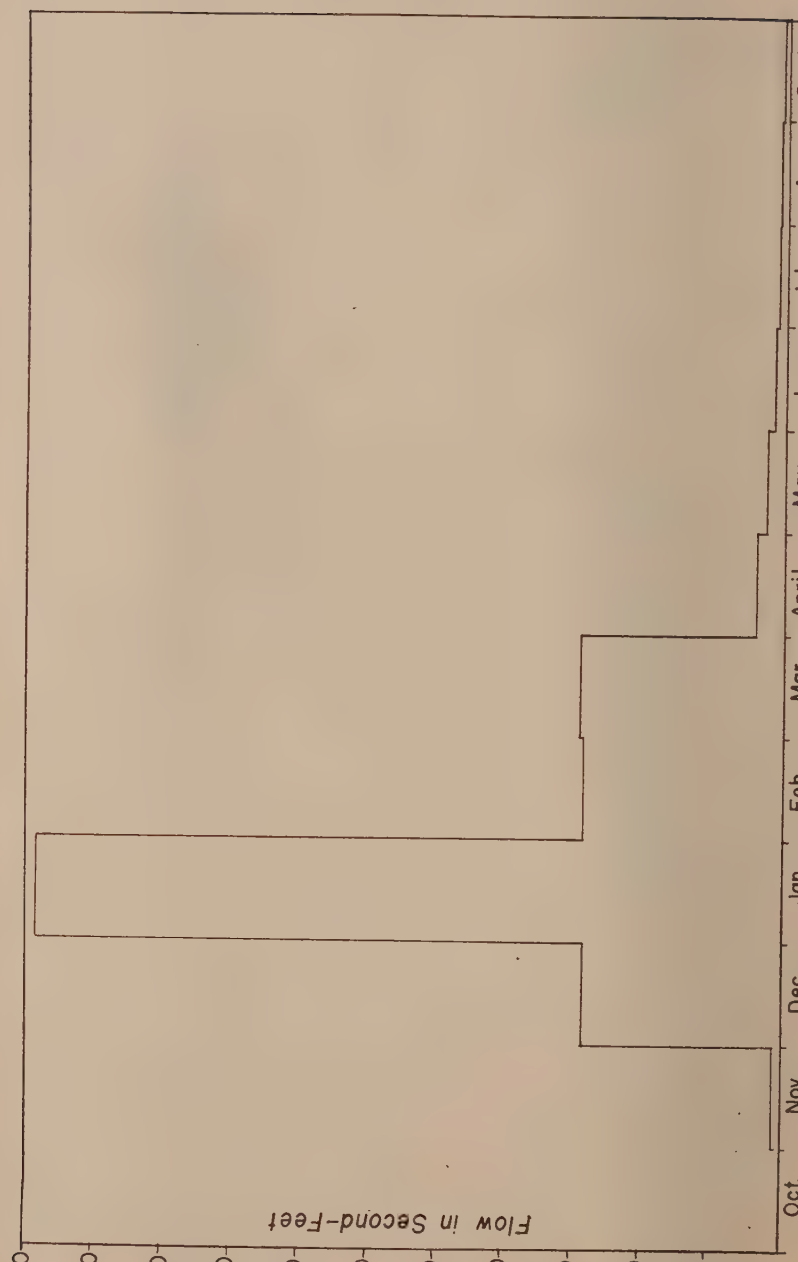

FIGURE 42. Mean monthly discharge in second-feet of Coyote Creek near Madrone, during 1921

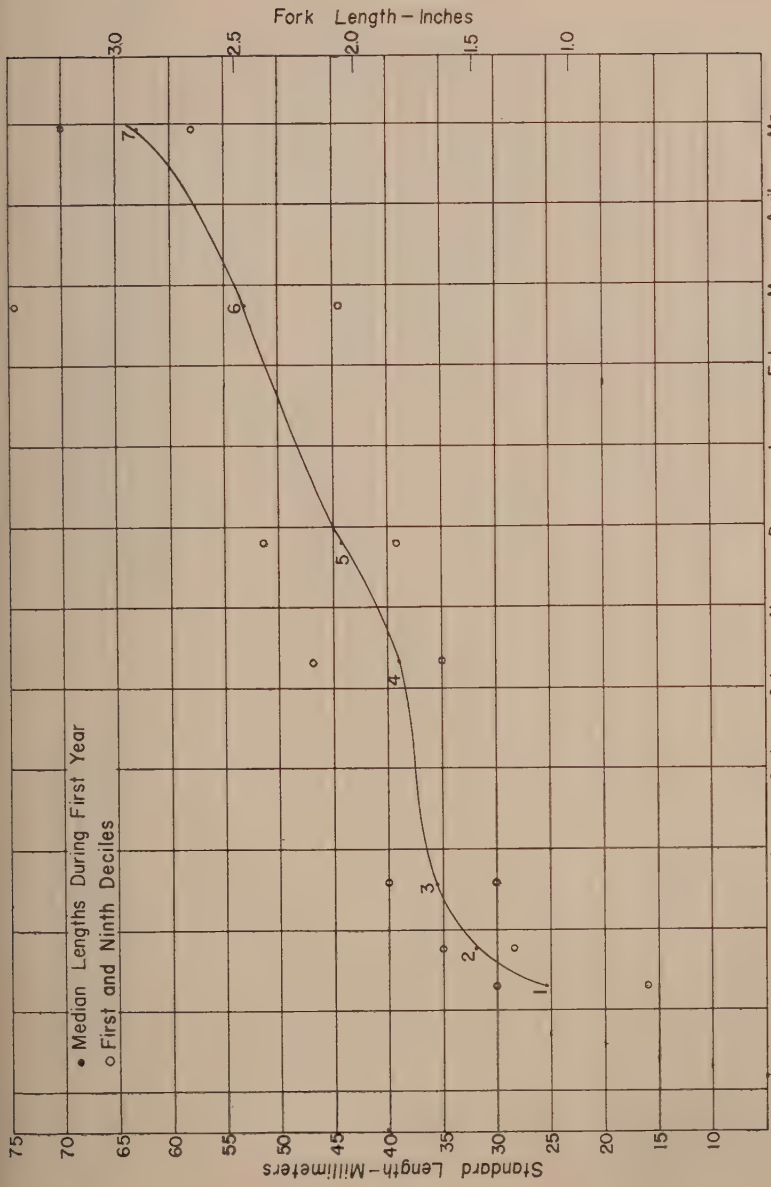

FIGURE 43. Growth of Coyote Creek squawfish through their first year

TABLE 1

Collections Used in the Growth Study

Date	Locality	Number of fish
December 9, 1926	Madrone—Coyote Creek	259
February 12, 1927	Madrone—Coyote Creek	1
March 7, 1927	Madrone—Coyote Creek	74
May 13, 1927	Madrone—Coyote Creek	76
June 24, 1927	Madrone—Coyote Creek	12
July 8, 1927	Madrone—Coyote Creek	125
August 2, 1927	Madrone—Coyote Creek	160
August 2, 1927	Madrone—Coyote Creek	22
October 25, 1927	Madrone—Coyote Creek	71
February 20, 1928	Madrone—Coyote Creek	67
August 8, 1927	Madrone Hot Springs—Coyote Creek	19
May 21, 1927	Salinas River near mouth	2
December 5, 1927	Pittsburg—Sacramento-San Joaquin River	14
February 8, 1928	Sacramento—Sacramento River	9
November 21, 1927	Sacramento—Sacramento River	1

From the curve it can be seen that the small fish have an extremely rapid growth from the time they are hatched in May until the early part of July. Growth gradually falls off during July, and from August to November there is very little growth. It is during this period that the stream is nearly dry. Furthermore, it will be noted that growth is resumed with the increase of the stream flow during November and continues at a constant rate until April, when the curve again turns up sharply.

In each group of the foregoing fish, examinations were made of the scales. The smallest fish of group 1 on which any scales were found was 21 mm. Three 16 mm. fish had no sign of scales. On the 21 mm. fish the scales were small, round plates without ridges, approximately the same size as the clear central area found in the scales of older fishes.

It might be expected that a check would show on the scales of the fish of the year as a result of the slow growth during August, September, and October, and the increase of growth during November and the following months. Such was not the case. In fact, there was no evidence of retarded growth on the scales until March. This is probably due to the fact that during August, September, and October the scale was growing at a much greater rate than the fish. That the scale was growing very fast at that time will be demonstrated later in Figure 45. The evidence of slow growth in March is most apparent on the scales of the larger fish.

Scales from several hundred fish at various times throughout a year gave a consistent pattern of scale growth for each year of life. The first annulus is formed in the spring, when a period of rapid growth (widely spaced circuli) follows the formation of the annulus. Slow growth (closely spaced circuli) follows and the time of its appearance coincides almost exactly with the time of low water in the streams. This pattern is so consistent that in only five of over 900 specimens was it impossible to determine the age. Figure 44 illustrates a typical scale.

Since it appeared that during the first year the scales and the fish had a different rate of growth, it would be of considerable importance to know whether this difference occurred during succeeding years.

The regression of scale size and fish length is plotted in Figure 45. The points indicated are the average fish lengths for each five units of scale size. The number of measurements used to determine each point are

FIGURE 44. Scale of 290-millimeter squawfish in its fifth year, Coyote Creek, February 12, 1927

indicated. The dotted lines connect points denoting three times the standard deviation for each distribution. Sufficient fish were available to make such a curve reliable up to a length of 140 mm. Beyond this point the fish were too few in number to use this method. If there is sufficient correlation between the regression of scale size and fish length and vice versa, the use of both regressions would make the measurements for the larger fish more reliable. When the two regressions for fish up to 140 mm. were plotted, it was found that there was a very close correlation. In Figure 46 the points beyond 140 mm. represent average scale and average fish length for the number of fish indicated. The curve below 140 mm. was smoothed by a moving average of three.

Figure 45 indicates that the scale appears at a fish length of about 20 mm., and that there is a very rapid initial growth until the fish is about 35 mm. long. This agrees very well with the observed fact that the smallest scale was found on a fish 21 mm. in length and that the scale grew at a rapid rate during the summer months of the first year when the fish was growing very little. From 35 to 160 mm. there is a constant proportional increase in the size of fish and scale. Beyond that point the scale growth is increasingly small in proportion to fish growth. At no point beyond 35 mm., however, does the scale grow at such a rate as to make it unreliable in judging the growth of the fish.

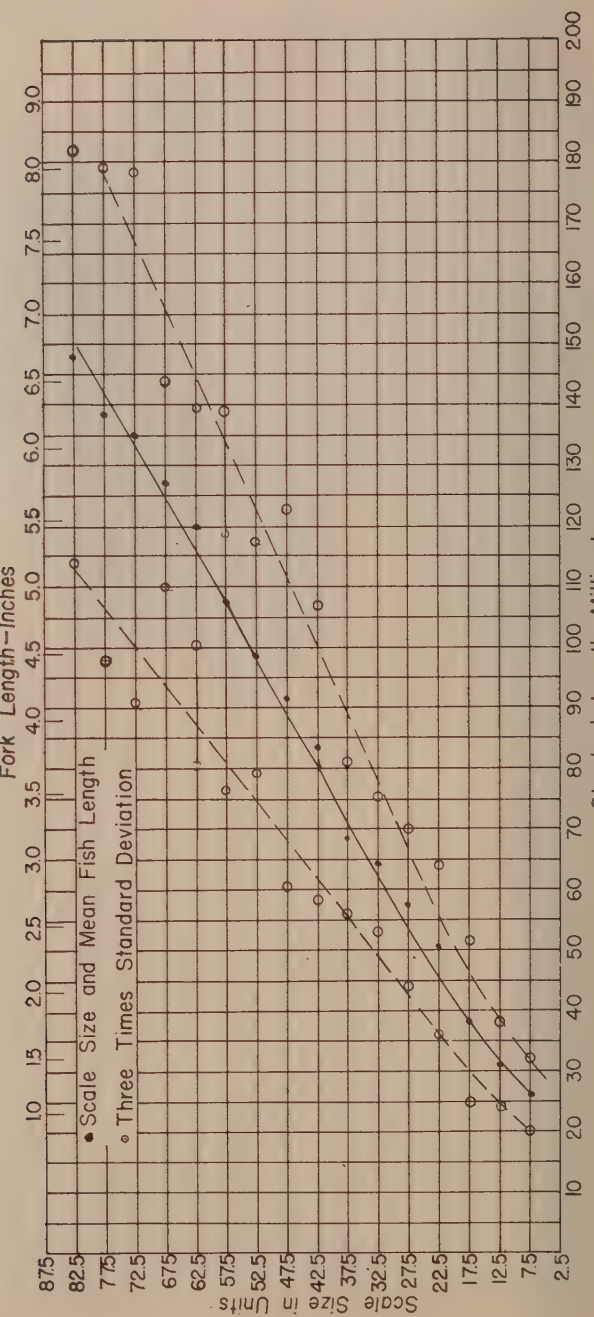

FIGURE 45. Regression of scale size and fish length for squawfish

The measurements used for Figure 46 were taken from fish from Coyote Creek and from the Sacramento River. All fish over 300 mm. in length were from the Sacramento. The largest fish from Coyote Creek was 298 mm. in length and five years old.

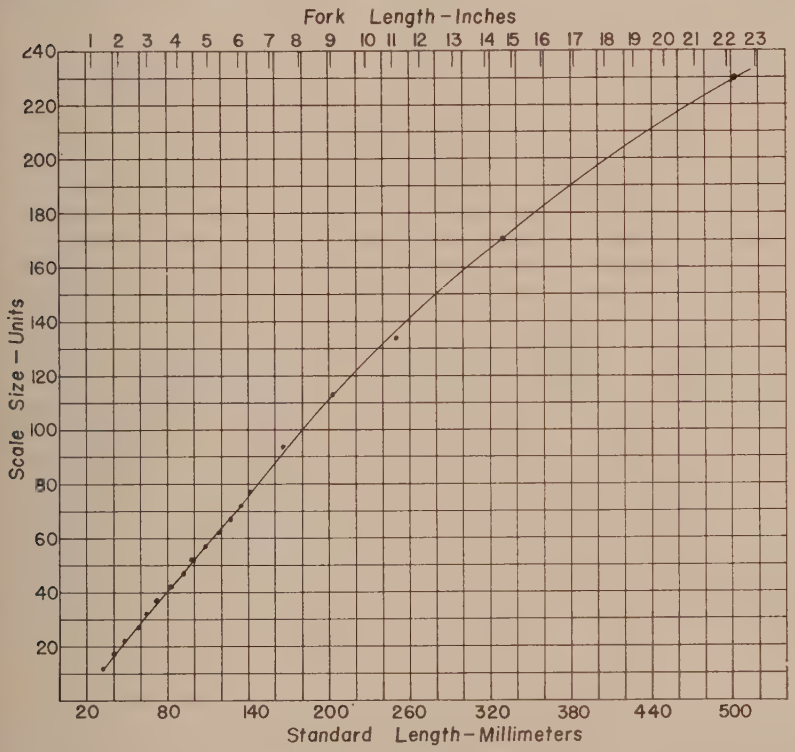

FIGURE 46. Regression of scale size and fish length for squawfish. Curve below 140 millimeters smoothed by a moving average of 3

The character of the central area of the scales of the larger fish from the Sacramento indicates that the growth of these fish was similar to that of fish from Coyote Creek. The size of the scale at the end of the first year is approximately the same in Sacramento fish as in those from Coyote Creek and the spacing of the ridges indicates the same cycles of growth.

As no small fish were available from the Sacramento, the only possibility of determining the early growth lay in the calculation of fish size from scale size at the different year marks.

Since the ratio of scale size to fish size is constantly changing, calculation of fish size at various annuli by direct proportion introduces a systematic error, the calculated lengths being too small. A simple method of compensating for this error is to apply the scale lengths directly to Figure 46 to determine the length at the various ages. However, a single scale cannot be applied directly to the curve, especially if the scales vary greatly in size, as they do in the squawfish. An illustration will be the best demonstration of this fact.

Given a fish 300 mm. in length with a scale 170 units in anterior-posterior diameter, and referring to Figure 46, it will be seen that the ordinate 170 does not coincide with the abscissa 300 at the average line but lies 11 units above it. In other words, the scale is larger than average for this length of fish. The size of this scale at the end of the first year was 30 units and at that time it was proportionally large for the length of the fish. If we want to apply this scale size to the curve we must reduce it

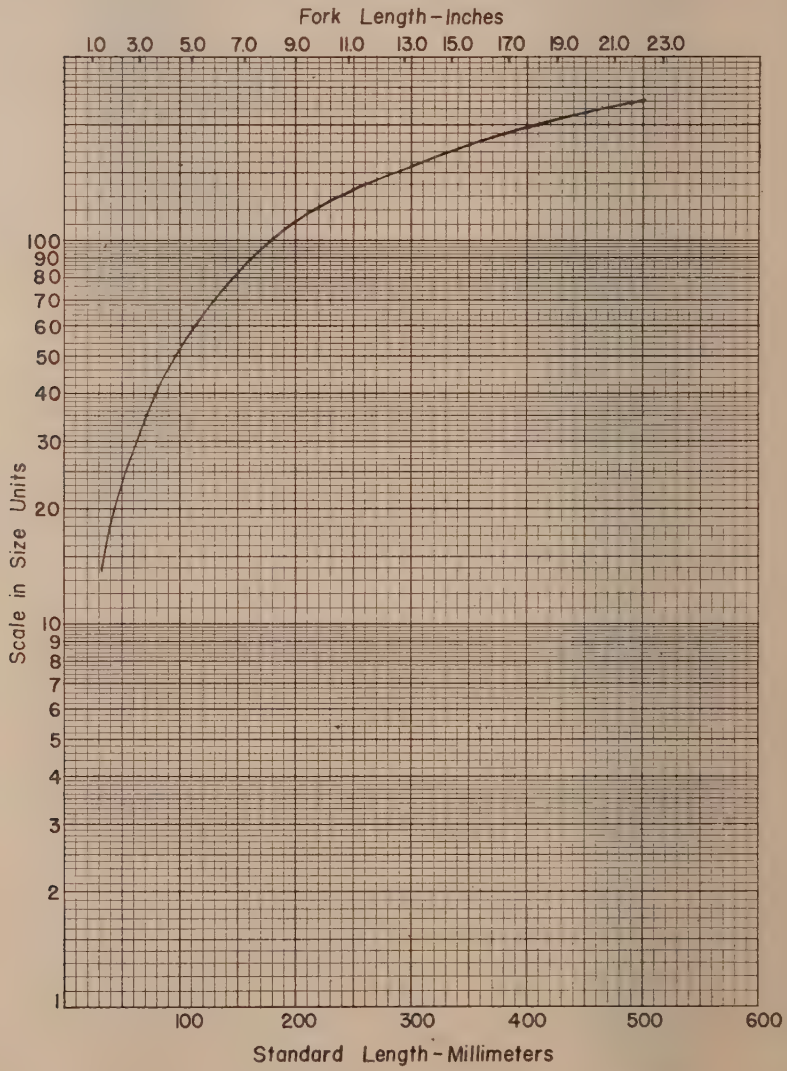

FIGURE 47. Regression of scale size and fish length for squawfish on semilogarithmic scale

proportionally, or 170 : 11 : : 30 : X. It must be reduced by X units to give the correct length of the fish at the time of formation of the first annulus.

To accomplish the transformation without calculation the curve of Figure 46 has been drawn on a logarithmic scale in Figure 47. The effect of the logarithmic scale is to give equal proportional value in units for equal distance on the ordinates. Using the data of the previous illustration in Figure 47, the ordinate 170 lies 1.5 mm. above the average line at the abscissa 300. To calculate the length at the end of the first year it is only necessary to find the point on the average curve which is 1.5 mm. directly below the ordinate 30. This would give a length at the end of the first year for this fish of 58 mm. Measurements of this kind can be done very quickly with dividers. The effect of the logarithmic scale is apparent if it is noted that 1.5 mm. above the average curve at abscissa 300 indicates an increase in scale size of 14 units, while at abscissa 58 it indicates an increase in scale size of 2.5 units.

Applying this type of correction assumes that a scale that is large at one time in the life of the fish is large at all times.

To test this in the squawfish, 21 scales were taken from the area below the dorsal of a four-year-old fish. Each scale was measured for the size at the different year marks and for total size. The data are shown graphically on a logarithmic scale in Figure 48. This graph demonstrates that, with minor exceptions, a scale which is small at the end of the first year is proportionally small throughout the four years.

To test this method of calculation two collections of fish were used. The first collection consisted of 69 fish from Coyote Creek, near Madrone Bridge, taken March 7, 1927. These fish were all completing their first year. As has been shown previously the year mark is formed during March. The second collection consisted of 53 fish taken in the same place February 20, 1928. These fish were all completing their second year, which would make them of the same year class as the fish of the first collection.

Using Figure 47 the lengths of this second lot at one year of age were calculated. Two curves showing the length frequency of the two groups at one year of age are given in Figure 49. The measures of central tendencies of the two groups are as follows:

	Mean	*Median*	*Mode*
Group 1	56.22	53.25	50.0
Group 2	51.47	52.12	50.0

The mean of group 1 is high because of a number of fish which were large for their age. In fact, six of them were larger than any in a collection of 76 fish of the same year class, taken in the same place June 13, 1927, two months after group 1 was taken.

In spite of the close correspondence of the medians it is still possible that the calculated lengths are too low. However, the difference is not large enough to affect greatly the value of the calculations.

Using this method the lengths at previous years were calculated for all fish over 1 year of age from Coyote Creek and from the Sacramento-San Joaquin at Pittsburg.

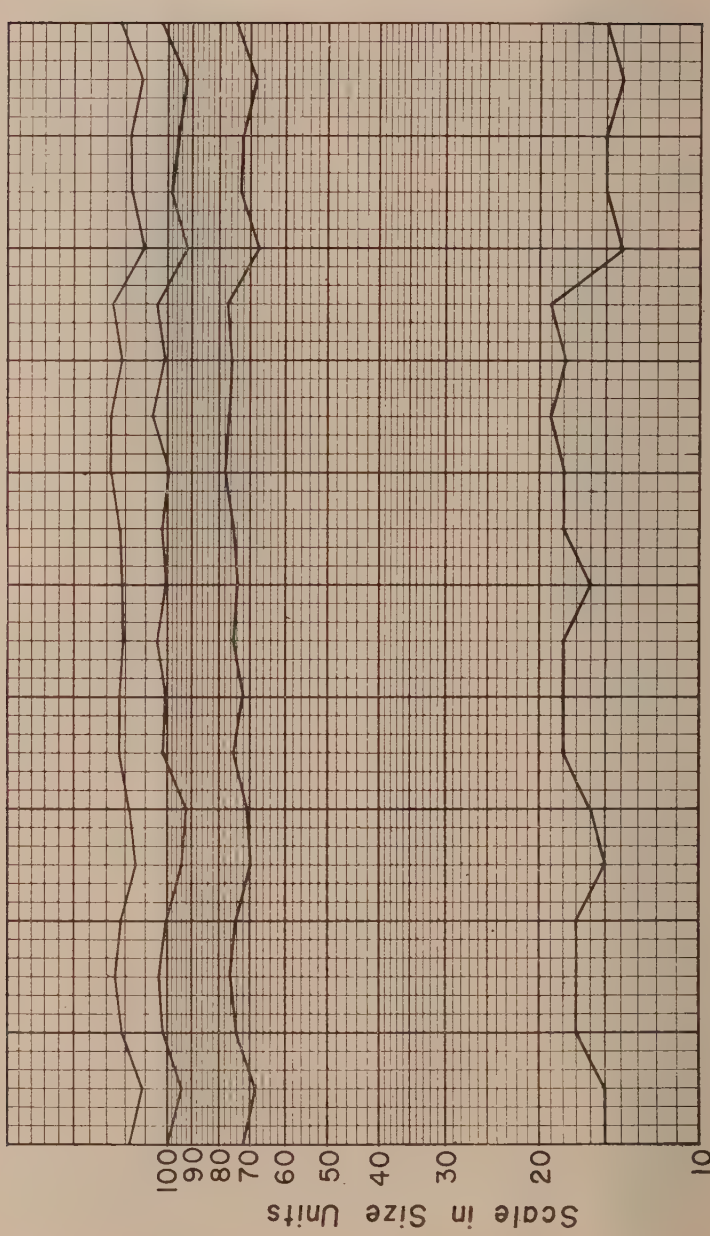

FIGURE 48. Proportional growth of individual scales through four years of life

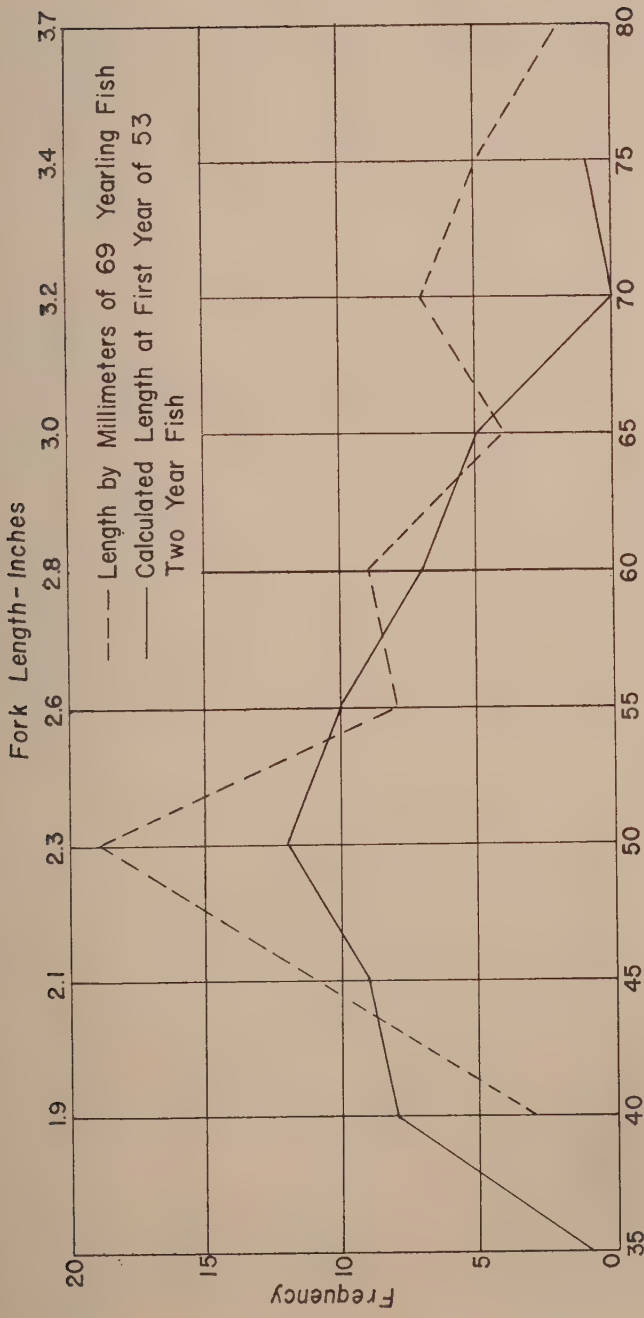

FIGURE 49. Comparison between actual length of a sample of fish at age I, and calculated length at age I of a sample of the same year class taken at age II

The calculated lengths of fish from Coyote Creek were combined with the actual lengths of fish which had nearly completed their year's growth when taken, and a curve was drawn showing the mean size at ages of from one to five years. This curve is shown in Figure 50. No fish over five years of age were taken in Coyote Creek.

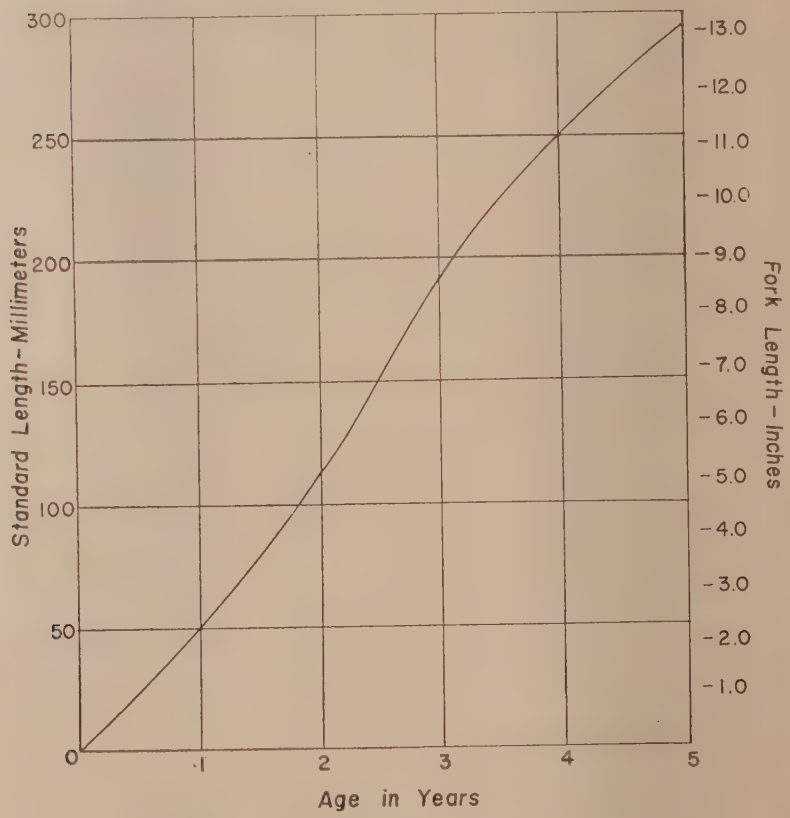

FIGURE 50. Growth curve of Coyote Creek squawfish

In Figure 51 are two curves showing the relative size and rate of growth of fish from Coyote Creek and from Pittsburg. A logarithmic scale is used in order to indicate the rate of increase in length. On such a scale the rate of increase is indicated by the slope of the curve, and the steeper the slope the greater the rate of increase. Where the curves are parallel it indicates the same rate of growth.

At the end of the first year the Sacramento fish were nearly 10 mm. larger than those from Coyote Creek. At the end of the second year they averaged nearly 30 mm. longer. At the end of the third, fourth, and fifth years the Sacramento fish were about 20 mm. longer than the Coyote fish. The Sacramento fish have a greater initial rate of growth, but the two become about the same at the end of the third year.

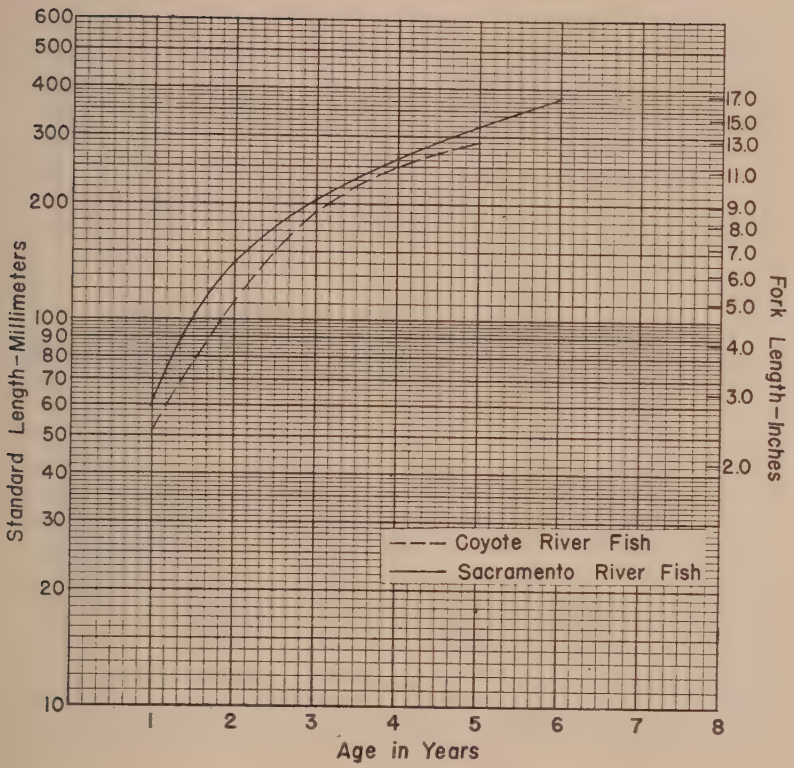

FIGURE 51. Growth curves of Coyote Creek squawfish and Sacramento River squawfish on a logarithmic scale

SUMMARY

The Sacramento squawfish is confined to the Sacramento-San Joaquin drainage basin and several small adjoining stream systems. It inhabits lowland and middle elevation streams and lakes. It frequently participates in spawning migrations, remaining in the spawning stream through the summer. The young compete with trout for food and "living room," and adults compete for space and probably prey on young trout. Spawning generally takes place during April and May. The adhesive eggs are deposited on stones in areas with running water.

The age of the squawfish can be determined by a study of the scales. An annulus or year mark is formed in March.

The maximum age of specimens examined from Coyote Creek was five years. The maximum age of fish from the Sacramento River was nine years.

The scale forms when the fish is about 20 mm. in length. The growth of the scale is very rapid during the early part of the first year. The scales and the fish do not grow in the same proportion at all times. During the greater part of the first year the scales grow proportionally faster than the fish, and during the second and third year the growth of the scales

and of the fish is in direct proportion. During the following years the scales grow proportionally less than the fish.

The length of the fish at the time of the formation of the annulus for any year can be calculated from the scales. A method is presented for doing this by the use of a curve showing the relation of scale size to fish length, drawn on a logarithmic scale.

Fish from the Sacramento River have a larger size and a higher growth rate than Coyote Creek fish during the first three years. During the fourth and fifth years the rate of growth is practically the same.

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NOTES

THE EXTENSION OF THE RANGE OF THE DEEP SEA FLOUNDER, *EMBASSICHTHYS BATHYBIUS* (GILBERT)

Two specimens of *Embassichthys bathybius* (Gilbert) were taken off Eureka on June 21, 1949, by the otter trawler *Ethel S.*, George Sibert, skipper. The catch was made in 190 fathoms on the north slope of the Eel River submarine canyon, 18 miles southwest of Eureka (Lat. 40° 38′ N; Long. 124° 29′ W). Previous records are from south of Monterey in depths of from 440 to 659 fathoms. The range is thus extended approximately 300 miles north. These fish were mixed with dover sole, *Microstomus pacificus*, which they resemble in general appearance. Mr. Sibert noticed their most distinguishing characters, the black mouths and the five bluish bars on their dorsal side.

Dr. Carl L. Hubbs of the Scripps Institution of Oceanography at La Jolla, California, examined and identified the two specimens and suggested the common name of "deep sea flounder."

This species was first described by Gilbert from two individuals that were taken in 603 fathoms from the Santa Barbara Channel (1890, Pro. U. S. Nat. Mus., XIII, p. 123). Jordan and Everman (1896, Rep. U. S. Com. Fish., XXI, 1895, p. 506) state that this species ranges along the California coast south of Point Conception. During the expedition of the *Albatross* in 1925, Townsend and Nichols obtained four specimens from 440 to 659 fathoms. These fish were taken between Monterey Bay and the Santa Barbara Islands (1925, Bull. Amer. Mus. Nat. Hist., LII, 1, p. 17). Barnhart (1936, Marine Fishes of Southern California, p. 31) states that this species is found in deep water off Southern and Central California.

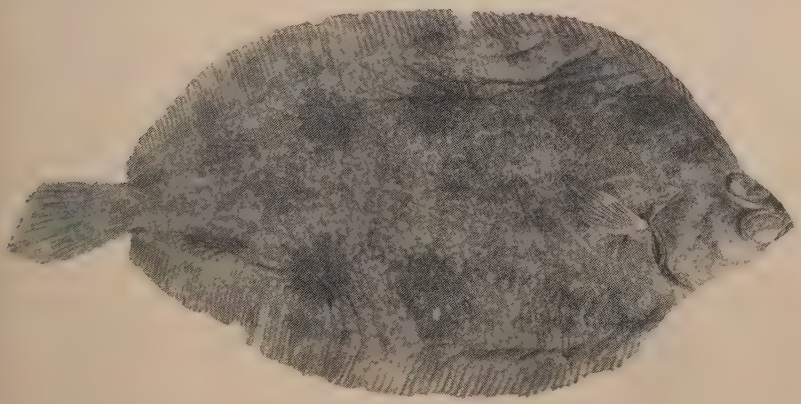

FIGURE 52. Deep sea flounder, *Embassichthys bathybius*. *Photograph by J. B. Phillips*

With the trawling fleet of Northern California extending its range of fishing into deeper water, there is a possibility that the deep sea

flounder will become of some future value to the market. The flesh of these two fish was firm, although the bodies were somewhat thin.

Since there is little complete data on *Embassichthys bathybius* published, Table 1 of counts and measurements is included.

TABLE 1

COUNTS AND MEASUREMENTS OF EMBASSICHTYS BATHYBIUS

	Eureka specimens		Norman 1934
	Millimeters		
	A	B	
Total length	464	408	
Standard length	408	352	
Depth	186	153	
Depth caudal peduncle	30	26	
Length head	88	78	
Length snout	17	14	
Diameter eye	26	25	
Interorbital space	4	4	
Length maxillary	18	14	
Snout to dorsal insertion	49	43	
Snout to ventral insertion	108	89	
Height dorsal	33	32	
Longest ray dorsal	33	32	
Longest ray pectoral	54	51	
Longest ray ventral	17	17	
Base dorsal	418	360	
Base anal	320	285	
Base pectoral	13	11	
Base ventral	9	8	
Dorsal rays	117	109	111–117
Anal rays	97	95	96–98
Ventral rays	5	5	5
Pectoral rays	11	11	11
Caudal rays	21	19	
Gill rakers (first gill arch)	10+14	10+13	+10 or 11
Standard length÷head	4.64	4.51	4-4 3/5
Standard length÷depth	2.19	2.30	2-2 1/8
Head÷snout	5.18	5.57	
Head÷eye	3.38	3.12	2 3/4-2 4/5

Table 1 shows a comparison of the two specimens from Eureka and the description by Norman (1934, A systematic monograph of the flatfishes (Heterosomata), vol. 1, p. 361). With some exceptions, these specimens fit Norman's description which is drawn largely from Gilbert. The dorsal and anal ray counts of specimen B are lower and for both fish the gill raker counts are higher and the diameter of the eye appreciably smaller, perhaps the result of different methods of measurement.—*Frederick B. Hagerman, Bureau of Marine Fisheries, Division of Fish and Game, December, 1949.*

RETIREMENT OF ELVIN C. ANDERSON

Elvin C. (Shorty) Anderson, Fish Hatchery Assistant, Mt. Shasta Hatchery, retired from State Service with the Division of Fish and Game on January 1, 1950.

Starting his employment with the Division on February 22, 1926, Mr. Anderson spent his entire period of employment at the Mt. Shasta Hatchery.

Our best wishes go to Mr. Anderson for a long and happy retirement.—*Earl Leitritz, Bureau of Fish Conservation, Division of Fish and Game, January, 1950.*

REVIEWS

A CONSERVATION HANDBOOK

By Samuel H. Ordway, Jr.; The Conservation Foundation, New York, 1949, 76 pp. $1.

This small handbook may be regarded as a primer to the field of conservation. The case for conservation is presented in simple language, by means of a logical sequence of definitions of the more important terms, concepts and practices used in conservation work. Hence, the book may be used also as a conservation dictionary. It offers little that is new to workers in this field. It should prove chiefly valuable as an introduction for beginners.—*William Dasmann, California Division of Fish and Game.*

THE VOICE OF THE COYOTE

By J. Frank Dobie. Illustrated by Olaus J. Murie; Little, Brown & Co., Boston, 1949, 386 pp. $4.

The author, J. Frank Dobie, an ardent observer of wildlife, has for the past 30-odd years collected information concerning the coyote. He begins his book "Originally I intended to make this book only a modest collection of coyote tales which their tellers had delighted me in telling, and which I delight in telling in my own way." Dobie has written of the coyote both as he is biologically and as he exists in human imagination.

As a one-time cowman, college professor, author and traveler, he has made an effort to meet many persons who, like himself, have taken an interest in watching the animals' behavior. Many of his chapters are accounts given by men who live on the plains, the mountains or the brush country—trappers, cattlemen and sheepmen, men who have spent their lives in the open among the coyotes. Some of the data were traced back to their Indian origin.

His observations have followed the coyote from birth throughout life and, as he has stated, "Anything but the impossible may be expected of a wild animal." Being a rather lengthy book it is not the type to read in one sitting but, as each chapter covers a different subject concerning the coyote, it affords the reader with many enjoyable evenings.

The humor of the old west which Mr. Dobie distributes in his chapters keeps the mass of biological data from distracting the interest of the average reader.

I feel that Mr. Dobie has contributed greatly to the searching multitudes of people who, like myself, wish to know more of our American wildlife and their activities in the field.—*A. A. Hightower, California Division of Fish and Game.*

THE GAME BIRDS OF HAWAII

By Charles W. Schwartz and Elizabeth Reeder Schwartz; illustrated by the authors, Division of Fish and Game, Board of Commissioners of Agriculture and Forestry, Territory of Hawaii, 1949, 168 pp.

This is a general account of the game birds of Hawaii. Introductory remarks include information on the geology, climate, vegetation, and land usage in the islands together with pictures and outline maps illustrating same.

The species are taken up individually with a description of the distribution and population, life history, and management recommendations for each. An accompanying outline map shows the distribution of each game bird. Detailed notes on food habits are also included.

At present all birds which are available for sport are exotic to the islands. The most important sporting birds are the ring-necked pheasant, California quail, and the lace-necked dove. A number of other species provide some sport or are potentially sporting birds.

It is of interest that many of the management practices recommended for Hawaiian species are similar to those used in California; namely, those practices that are related to problems arising from lack of water, excessive brush, over grazing, reclamation of marsh lands, and encroachment of cultivation into wild areas.

This book is profusely illustrated and reads easily. It is suited for both the general public and professional wildlife technicians.—*Carol M. Ferrel, California Division of Fish and Game.*

IN MEMORIAM

GENERAL H. H. ARNOLD

"Hap" Arnold, throughout the sixty-three years of his life, enjoyed the out-of-doors. Despite an extremely active military career, climaxed by his service throughout World War II as Chief of the Air Forces, he managed to find time for his favorite sports of hunting and fishing.

In 1946, after he retired from active duty to his ranch in California's Valley of the Moon, I was privileged to name General Arnold a member of the Fish and Game Commission. He served with distinction both as a Member of the Commission and later as Commission President.

With the death of General Arnold on January 15, 1950, the sportsmen of California lost a devoted friend, and the State a distinguished citizen who worked wholeheartedly for the conservation of our natural resources.—*Earl Warren, Governor, State of California.*

REPORTS

FISH CASES

October, November, December, 1949

Offense	Number arrests	Fines imposed	Jail sentences (days)
Abalone: Undersize, failure to show license on demand, overlimit, using diving apparatus in Dist. 19A, no license, abalone out of shell, taking abalone in Marine Life Refuge, failure to keep accurate books, failure to deliver triplicate copies of fish tickets to commission, using another's license	54	$1,760 00	12½
Albacore: Sale of undersized albacore	1	150 00	----------
Angling: No license, possession of gill net on a boat in Dist. 2, possession of spear on Shasta River, night fishing, fishing closed waters, closed season, fishing without a valid license, taking fish other than by angling, using a borrowed license, 2 lines, failure to show fish in possession on demand, failure to show license, possession of gaff within 300 ft. of a stream, possession of spear within 300 ft. of a stream, fishing from lower side of a dam, 2 poles, transferring angling license to another person, possession of fish spear on spawning beds	143	2,475 00	42
Black bass: Selling bass	1	250 00	----------
Kelp bass: No license	1	25 00	----------
Rock bass: Overlimit	7	185 00	----------
Striped bass: Possession of striped bass on commercial boat netting operating, undersize, overlimit, no license, 2 lines, night fishing, failure to show fish on demand, mutilated fish and game plates	71	1,892 50	----------
White sea bass: Possession on a purse seiner, undersize	3	100 00	----------
Bluegill: Overlimit, fishing too close to a dam	4	105 00	----------
Catfish: Using fyke nets in a closed district, undersize, night fishing, set line, no license, overlimit, sale of undersized catfish	12	745 00	----------
Chumming: In inland waters, using 2 lines	5	125 00	----------
Cockle clams: Overlimit, undersize, using another's sport fishing license, no license	38	735 00	18
Pismo clams: Using appliance other than provided for to take clams, unlawful possession of clams, overlimit, undersize, no license, night clamming, using invalid angling license	160	3,545 00	----------
Commercial: No license, failure to keep party boat records, no commercial boat registration, no party boat license, setting a round haul net in Dist. 15, failure to give a true weight on required records, failure to make out fish receipts, failure to deliver tickets to fish and game officers	53	1,885 00	----------
Corbina: Spearing	1	10 00	----------
Crabs: Closed season	4	125 00	----------
Crappie: Overlimit	1	25 00	----------
Lobsters: Possession and sale of undersized lobsters, failure to show license on demand, closed season, using fishing traps in Dist. 20	28	2,197 00	----------
Pollution: Using petroleum in state waters, use of copper sulphate, pumping fish bilge directly into waters of State	15	1,375 00	----------
Salmon: Spearing, snagging, closed season, using fyke nets, using a borrowed license, fishing on spawning area, overlimit, no commercial license, closed stream, night fishing, 2 lines	48	1,395 00	100
Sardines: Using illegal net in closed portion of Dist. 16, no commercial fishing license, taking sardines for use by a packer in closed season, use of a purse seine net in Dist. 20	28	1,475 00	----------
Shark: No license	3	----------	----------
Trout: Using 2 rods, set line, closed area, taking trout by hand, overlimit, using 3 attractor blades, no license, closed season	28	900 00	----------
Yellowfin croaker: Overlimit	2	25 00	----------
Yellowtail: Purchase of undersize, selling of undersize	2	20 00	----------
Totals	713	$21,524 50	172½
Court forfeitures: (Confiscated fish)	----------	$1,742 15	

GAME CASES

October, November, December, 1949

Offense	Number arrests	Fines imposed	Jail sentences (days)
Antelope: Closed season, taking a female antelope, using a borrowed license, using a borrowed license tag, illegal possession	6	$600 00	425
Bear: Closed season	2	125 00	
Deer: Closed season, doe, taking spike buck, failure to fill out and attach deer tag, taking a forkedhorn deer in Dist. 1¾, night hunting, transferred tags, no tags, spotlighting, failure to have deer tags countersigned, taking a spotted fawn, using "A" tags in a "B" tag district, failure to retain hide and horns, altering and defacing a deer tag, possession firearms in a refuge, no license, using a .22 caliber rifle, using full metal jacketed bullets, overlimit, California resident taking deer with a Utah resident license, removing evidence of sex, no transport permit, possession overlimit of does, failure to show game on demand, allowing dogs to run deer in closed season	203	15,776 00	1,015
Deer meat: No evidence of sex, wrong license, California resident possession deer meat with a Nevada resident license, closed season, no tags, no license, no transport permit, unstamped deer meat, possession illegal deer meat, possession canned meat, possession female deer, night hunting	29	2,535 00	925
Doves: Closed season, overlimit, shooting from a car, unplugged gun, late shooting, possession dove nest and eggs, no license	48	2,265 00	
Ducks: Closed season, late shooting, overlimit, killing ducks in a game refuge, unplugged shotgun, shooting from a power boat, early shooting, California resident using Utah resident license, no license, using borrowed license, no duck stamp, shooting ducks from an airplane, closed area, shooting from a car	200	8,415 00	
Elk: California resident possessing elk meat with an Idaho resident license, overlimit, taking cow elk with a bull permit	2	350 00	
Geese: Overlimit, shooting from a power boat, hunting in a refuge, hunting in California without a valid license, closed season, late shooting	41	1,177 50	
Hunting: Possession shotgun which is unplugged, night hunting, hunting with full metal jacketed shells, possession firearms in refuge, shooting from a motor boat, spotlighting, no license, making a false statement of residence when applying for a license, shooting from a public highway, shooting from a car, trespassing in a Game Management Area, hunting in closed zone of a cooperative hunting area, failure to sign permit before hunting, shooting on posted land, using a .22 caliber rifle, failure to return arm bands before leaving cooperative area, permit hunting on a G. M. A. without a dog in the group, nonresident using a resident license	232	5,185 00	360
Pheasant: Closed season, no license, untagged male pheasant, taking a hen pheasant, .22 caliber rifle, hunting in a closed zone of a cooperative hunting area, shooting from a car, overlimit, no evidence of sex, late shooting, failure to show game on demand, transferred tag, early shooting, no tags, unplugged gun, possession illegal pheasants, shooting from a public highway, taking pheasant in cooperative hunting area without a permit, illegal importing of pheasants	188	8,460 00	100
Pigeons: Closed season	1	100 00	
Migratory waterfowl: Closed season, late shooting, early shooting, no license, .22 caliber rifle, shooting from a power boat, taking a fully protected bird, unplugged gun	57	1,780 00	
Moose: California resident possessing moose meat on a Montana resident license	1	100 00	
Nongame birds: Taking nongame birds, no license	6	426 00	
Quail: Closed season, overlimit, taking quail with a trap, illegal gun, no license, failure to declare birds taken in Mexico	16	880 00	
Rabbits: No license, closed season, unplugged shotgun, hunting without a valid license, night hunting, early shooting, spotlighting	35	830 00	
Shorebirds: Taking snipe, taking plover, taking and possession in closed area, taking an avacett, taking a Pacific loon	6	175 00	
Squirrels: Killing tree squirrel in closed season, possession grey squirrels in closed area, killing tree squirrel in closed district	15	400 00	
Totals	1,088	$49,579 50	2,825

SEIZURES OF FISH AND GAME

October, November, December, 1949

Fish:	
Abalone	1,034
Albacore, pounds	1,770
Rock bass	151
Sand bass	25
Striped bass	264
White sea bass, pounds	1,400
Bluegill	72
Catfish	39
Catfish, pounds	158
Cockle clams	10,355
Pismo clams	2,938
Pismo clams, pounds	31
Corbina	1
Crabs, pounds	44
Lobsters	611
Lobsters, pounds	622
Octopi	10
Salmon	44
Salmon, pounds	150
Sardines	8
Sardines, pounds	153,500
Sturgeon	1
Trout	276
Yellowfin croaker	28
Yellowtail, pounds	6,332
Game:	
Antelope	4
Deer	110
Deer meat, pounds	699
Doves	699
Ducks	627
Elk	2
Elk, pounds	50
Geese	110
Moose meat, pounds	30
Nongame birds	9
Pheasants	142
Pigeons	10
Quail	42
Rabbits	30
Shorebirds	36
Squirrels	20
Migratory waterfowl	21

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